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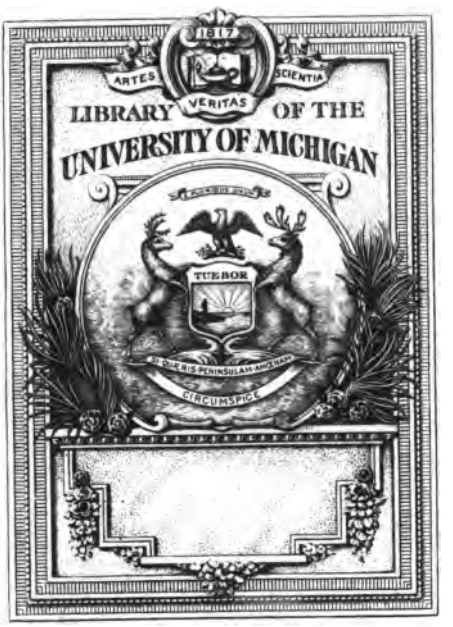


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U. S. DEPARTMENT OF AGRICULTURE.

# TWENTY-EIGHTH ANNUAL REPORT

OF THE

# U.S. BUREAU OF ANIMAL INDUSTRY

FOR THE YEAR

# 1911.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1913.

[STATUTES AT LARGE, VOL. 28 (CHAP. 23), P. 601.]

AN ACT Providing for the public printing and binding and the distribution of public documents.

SEC. 73. Extra copies of documents and reports shall be printed promptly when the same shall be ready for publication, and shall be bound in paper or cloth as directed by the Joint Committee on Printing, and shall be the number following in addition to the usual number:

Of the report of the Bureau of Animal Industry, 30,000 copies, of which 7,000 shall be for the Senate, 14,000 for the House, and 9,000 for distribution by the Agricultural Department.

Approved, January 12, 1895.

Cycl.
N.C. St. Coll.
2-28-40

# LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
*Washington, D. C., September 10, 1912.*

SIR: I have the honor to transmit herewith the Twenty-eighth Annual Report of the Bureau of Animal Industry, for the year 1911, and recommend that it be published, as provided by section 73 of the act of Congress approved January 12, 1895.

Respectfully,

A. D. MELVIN,
*Chief of Bureau.*

Hon. JAMES WILSON,
*Secretary of Agriculture.*

## ORGANIZATION OF THE BUREAU OF ANIMAL INDUSTRY.

*Chief:* A. D. MELVIN.
*Assistant Chief:* A. M. FARRINGTON.
*Chief Clerk:* CHARLES C. CARROLL.
*Animal Husbandry Division:* GEORGE M. ROMMEL, chief.
*Biochemic Division:* M. DORSET, chief.
*Dairy Division:* B. H. RAWL, chief.
*Field Inspection Division:* R. A. RAMSAY, chief.
*Meat Inspection Division:* R. P. STEDDOM, chief.
*Pathological Division:* JOHN R. MOHLER, chief.
*Quarantine Division:* RICHARD W. HICKMAN, chief.
*Zoological Division:* B. H. RANSOM, chief.
*Experiment Station:* E. C. SCHROEDER, superintendent.
*Editor:* JAMES M. PICKENS.

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# TWENTY-EIGHTH ANNUAL REPORT OF THE BUREAU OF ANIMAL INDUSTRY.

## REPORT OF THE CHIEF OF THE BUREAU FOR THE FISCAL YEAR ENDED JUNE 30, 1911.

By A. D. MELVIN.

### INTRODUCTION.

The bureau deals with the live-stock industry in a threefold way, comprising administrative, research, and educational work. This work includes the inspection of animals, meat, and meat food products in connection with interstate and export business under the law of June 30, 1906; the inspection of animals for export; the inspection and quarantine of imported animals; the eradication of contagious and infectious diseases of live stock; the scientific investigation of such diseases; investigations in the breeding and feeding of live stock and poultry; work relating to the dairy industry; and the diffusion of information on these subjects.

The number of employees in the service of the bureau on July 1, 1911, was 3,284, as compared with 3,183 a year before.

After a brief general discussion of certain features the work of the various divisions of the bureau's organization will be presented in order and more in detail.

### STUDY AND ERADICATION OF ANIMAL DISEASES.

The work of controlling and eradicating certain contagious and infectious diseases of live stock has been carried forward with very favorable results.

Since the summer of 1906 the bureau has been engaged, in cooperation with the State and local authorities, in the extermination of the ticks which inhabit the Southern States and which spread the infection of the disease known as southern or Texas fever of cattle and otherwise handicap the cattle and dairy industries by keeping animals in poor condition. Good progress was made in this undertaking during the past fiscal year, as a result of which areas aggregating 10,965 square miles were released from quarantine, making the total territory so released since the beginning of the work 139,821 square

miles. This territory is mostly along the northern border of the infected region, extending from Virginia to California.

Experiments in dipping cattle for the destruction of the ticks have shown that arsenical solutions are more satisfactory than the Beaumont crude petroleum which has heretofore been used to a considerable extent. Arsenical dips are therefore now being principally employed in the work of tick eradication, and articles have been prepared for publication reporting the results of the dipping experiments and giving directions for the preparation and use of arsenical dips and for the construction of dipping vats. A paper discussing the history and progress of the work of tick eradication has also been prepared for the Twenty-seventh Annual Report of the Bureau.

Substantial progress was also made during the fiscal year in the eradication of the parasitic diseases known as sheep scab and cattle mange. Statistics of this work, as well as of tick eradication, appear in the portion of this report dealing with the work of the Inspection Division. In addition to the territory released from quarantine, the amount of infection in some of the areas remaining under quarantine has been considerably reduced.

The form of necrobacillosis known as lip-and-leg ulceration of sheep, which has been quite prevalent in a malignant form in a large part of Wyoming and Montana within the past three years, was brought under control so well during the fiscal year as a result of work done by the bureau and State officers, with favorable climatic conditions, that the Federal quarantine was entirely released under date of August 10, 1911. While the disease is still sometimes found in mild form, it is believed that ordinary methods of State and interstate inspection will be sufficient to keep it under control. It is fortunate for the sheep industry that the malignant form of the disease was stamped out within such a short time and not allowed to spread extensively throughout the West.

The recurrence of the contagious disease known as dourine of horses was an incident of the year. This disease had apparently been completely eradicated a few years before as a result of several years' work by the bureau. The new outbreak occurred in Iowa, and while the manner in which the infection was again introduced has not been positively determined, all the information at hand points to its having been brought in with an imported stallion. Prompt and vigorous action by the bureau in concert with the State authorities has resulted in the practical eradication of the contagion. In studying the disease the scientists of the bureau were able to find under the microscope the living organisms which are the infective agent, this being the first discovery of the organism in natural cases in the United States. Further details of the outbreak and its study and eradication are given in the report of the Pathological Division.

Although mallein has been in use for the diagnosis of glanders for several years, it has not been entirely reliable. During the year the bureau scientists have made a special study of a new laboratory test for glanders known as the complement-fixation test, and the first description of this test published in the United States was issued as a bulletin of the bureau. The new test has been found to be highly accurate and reliable and affords a very valuable means of determining doubtful cases of glanders in horses and of bringing about its eradication.

### TUBERCULOSIS.

Tuberculosis has continued to be a subject of both administrative work and scientific investigation. In 1909 and 1910 a systematic tuberculin test was made of all cattle in the District of Columbia, and those that reacted were slaughtered. During the past fiscal year the bureau has been engaged in making retests at intervals in order to detect the disease in any animals in which it might have developed since the first test. This work is described in the report of the Quarantine Division. Only a small proportion of cases is now being found, and as all cattle brought into the District except for immediate slaughter have to undergo the test, it is believed that the District will soon be entirely freed from bovine tuberculosis.

Experiments in the immunization of cattle against tuberculosis by means of vaccination have been continued, and while some encouraging results have been obtained, the only methods that appear to be at all reliable require the use of living tubercle bacilli, and the bureau does not yet consider such methods adapted to practical use because of the danger of spreading the disease. This work has been made the subject of a special article in the Twenty-seventh Annual Report of the bureau.

For several years the bureau has advocated that only animals that are free from tuberculosis should be admitted to public exhibitions. Following this recommendation the officials of the Utah State Fair last year made a ruling which permitted only cattle which were free from tuberculosis as demonstrated by the tuberculin test to be shown at that fair. It is hoped that the managers of other large exhibitions will follow a similar course. This policy seems desirable for two reasons—first, because if tuberculous animals are admitted there is danger that the disease will be spread to other stock, and second, it seems unreasonable and unfair that premiums should be awarded to animals that are infected with a contagious disease. Certainly, the owners of healthy stock should not be expected to expose their animals to diseased ones at these fairs.

About two years ago a special committee known as the International Commission on the Control of Bovine Tuberculosis was

appointed by the American Veterinary Medical Association to study the tuberculosis problem in live stock and to formulate measures for dealing with it. The report of this commission was submitted during the past fiscal year, and owing to its importance and the desirability of giving it a wide distribution it was published by the department as a circular of this bureau. The commission has since prepared a simple and concise treatise on this disease, intended especially for farmers and stock raisers, and it is expected that this will be published by the department as a Farmers' Bulletin. As a proper understanding of the nature of tuberculosis and the best means for dealing with it are essential to the success of any undertaking for the control or eradication of this disease, it is believed that the widespread distribution of this literature will accomplish great good.

### NEW EXPERIMENTAL FARM AND QUARANTINE STATIONS.

As stated in my last report, a farm of about 475 acres, located at Beltsville, Prince Georges County, Md., about 13 miles from Washington, was purchased under an appropriation made by the appropriation act for the Department of Agriculture for the fiscal year ending June 30, 1911. This farm was intended for experimental work in animal husbandry and dairying. For several years it had been considered very desirable to separate work of this kind from that relating to infectious diseases as carried on at the Bureau Experiment Station at Bethesda, Md. During the past year considerable work in the way of building, fencing, and equipping the Beltsville farm for work for which it is intended has been carried on, and the work of breeding and feeding animals and poultry has been transferred there from the Bethesda station.

With an appropriation of $65,000 made by Congress two quarantine stations have been purchased, to replace rented ones, for the detention of imported animals brought in at the ports of Boston and Baltimore. The station for Boston is located at Littleton, Mass. The Baltimore station is located on the water front and makes it possible to transfer live stock by lighter directly from the steamer to the station.

### BREEDING HORSES FOR THE UNITED STATES ARMY.

As pointed out somewhat at length in my last report, there is great need for the Government to undertake some systematic plan for encouraging the breeding of horses of a type suitable for Army use. The breeding of this type of horse is declining rapidly in favor of breeding heavier horses and it is becoming evident that if the Army is to be able to procure an adequate number of suitable horses in the future some plan such as has been recommended will have to be entered into. During the year a hearing on this subject was held by

the Committee on Agriculture of the House of Representatives, but no special appropriation for such work was made by Congress. However, the bureau has made a small beginning, the slight expenses of the work being paid from the appropriation for animal feeding and breeding experiments. During the year Mr. August Belmont presented to the War Department two well-known thoroughbred stallions, Henry of Navarre and Octagon, and, at the request of the Secretary of War, the Department of Agriculture consented to take the stallions and stand them for public service under the provisions of the plan outlined in the preceding report. The stallions are at the remount station of the Army at Front Royal, Va., and have been bred to about 50 mares, each mare owner agreeing to give the Government an option on the foal at three years at $150 in return for stallion service. The conditions for service also provide for disqualifications for faulty gait and conformation and unsoundness.

## VETERINARY EDUCATION.

In order to obtain qualified veterinarians for its service, the bureau, in conjunction with the United States Civil Service Commission, has continued its investigations and supervision with regard to the courses of study and facilities for instruction at veterinary colleges. This work may be better understood from a brief review, including the circumstances leading up to it.

The veterinary inspectors of the bureau were placed in the classified service by Executive order dated May 28, 1894, and the first examination was held by the Civil Service Commission June 22, 1894. To be eligible for the examination the only restriction made was that the applicant should be a graduate of a veterinary college. This remained in effect until July 1, 1899, when the standard was raised and the requirement made that the applicant should be a graduate of a veterinary college having a course of not less than three years. This was changed in January, 1900, to the requirement that veterinarians were eligible who were graduated during or prior to 1897 from veterinary colleges having a course of two years, while those graduated after that date must be from colleges having a course of three years. This standard was modified again in January, 1903, by requiring that applicants from a veterinary college having a course of three years must have spent at least two years in the study of veterinary science at a veterinary college. The necessity for this provision arose from the fact that certain veterinary colleges inaugurated the custom of giving degrees after one year of attendance and allowed two years' credit for time previously spent at agricultural, medical, or other colleges.

The demand for veterinarians for employment in practice and in the work of the bureau was so great that the existing veterinary

colleges were not able to supply the requisite number. Some colleges did not give sufficient attention to the preliminary education of the students enrolled and were not particular as to the scope of the instruction given, the number of branches taught, and the length of the course. For this reason it was found that although some of the graduates were able to pass the somewhat restricted civil-service examination, a considerable number were not sufficiently educated to make satisfactory inspectors and were not professionally qualified for the important duties assigned to them.

Accordingly it was deemed advisable to adopt some means to designate the course of study, as an adjunct to the examination which should be provided by colleges that wished to prepare graduates for the civil-service examination for veterinary inspector. In order to obtain expert advice as to the subjects to be included in a proper curriculum and the amount of time (number of hours) to be devoted to each, the Secretary of Agriculture in February, 1908, appointed five representative and qualified veterinarians as a committee on veterinary education, for the purpose of obtaining information regarding the course of instruction then given at veterinary colleges and to make recommendations as to the matriculation examination and the course of instruction necessary to qualify graduates of these colleges for admission to the civil-service examination for the position of veterinary inspector in the Bureau of Animal Industry.

This committee visited the various colleges for the purpose of obtaining the desired information, and as a result of its inquiry made recommendations as published in Circular 133 of the Bureau of Animal Industry. This circular was distributed generally, and most of the veterinary colleges proceeded at once to put the recommendations into effect.

On January 21, 1909, on my invitation a conference of representatives of all the veterinary colleges of North America met at Washington to consider with the committee above mentioned the whole matter of matriculation and course of study. The committee's recommendations in the main were heartily approved by the conference, but it was decided to reduce the total number of hours in the course from 3,200, as required by Circular 133, to 3,000. By this reduction the student is still required to have instruction for an average of $6\frac{2}{3}$ hours per day for 6 days per week for 25 weeks for 3 years in order to cover the required 3,000 hours. The Association of American Medical Colleges recommends in colleges for the study of human medicine a curriculum of $33\frac{1}{3}$ hours per week, while the present regulations for veterinary colleges require for day colleges $38\frac{2}{3}$ hours per week and for night colleges $29\frac{2}{3}$ hours per week. While night instruction is discouraged and has been practically discontinued by all but two colleges, it was deemed advisable to make provision for

it, as there seemed to be a demand for classes after office or work hours, particularly in Washington. It was therefore decided to fix the course for night colleges at 8½ months, exclusive of final examination and holidays, as compared with 6½ months for day colleges.

In March, 1909, there was appointed within the Bureau of Animal Industry a committee on veterinary education, consisting of Dr. A. M. Farrington and Dr. R. W. Hickman. This committee, commencing on March 17, 1909, visited all the veterinary colleges and made an inspection of each, obtaining all possible information regarding the manner in which each college was complying or failing to comply with the recommendations of Circular 133. A confidential report was sent to each college visited, stating wherein, in the opinion of the committee, improvements could be made and deficiencies corrected.

Their reports were well received, and marked improvement has resulted in the curriculums of many colleges.

In the efforts to secure suitable veterinary inspectors properly qualified and educated in the veterinary profession there has been active cooperation of the United States Civil Service Commission, which brought about the issuance of regulations governing entrance to the veterinary inspector examination, effective September 1, 1909, approved conjointly by the Secretary of Agriculture and the president of the commission. These regulations were published as Bureau of Animal Industry Circular 150, which contains a list of the accredited veterinary colleges, graduates of which can be enrolled for the veterinary inspector examination. This list is subject to change, and any college failing to comply with the requirements is removed from the list until such time as there is faithful and explicit compliance.

The result of these measures has been not only to make it possible for the bureau to obtain men better educated and qualified for its veterinary work but to raise the standard of veterinary education in the United States and to provide students with larger and better facilities for study. Many of the veterinary schools have made large expenditures of money and have greatly augmented and improved their equipment and facilities since the regulations were issued. The majority of the schools have cooperated heartily with the bureau in bringing about improvement and have cheerfully complied with the official requirements. The officials of several schools have expressed their appreciation of the bureau's efforts and their desire that its supervision should be continued, and some have said that until they found it necessary to make certain improvements in order to meet the bureau's requirements they had not realized that their schools were deficient in those particulars.

The department assumes no direct authority or control over the veterinary colleges; it merely undertakes, in conjunction with the

Civil Service Commission, to prescribe certain requirements for admission to the examinations for veterinary positions in its own service with a view to obtaining the services of qualified men. In order for the graduates of a college to be eligible to such positions the college must provide the required facilities for instruction.

## NEEDED LEGISLATION.

As indicated in previous reports, further legislation by Congress is needed in order to enable the department to exercise efficient control over certain matters in the interest of the live-stock industry and for the public good.

With the growing use in veterinary practice of vaccines, serums, antitoxins, tuberculins, and other preparations for the detection, prevention, or treatment of diseases of animals, and the increasing imports of such products, there is constant danger that contagious diseases may be introduced from abroad and cause great damage, as happened a few years ago in the outbreaks of foot-and-mouth disease. Furthermore, these preparations, as shown by the bureau's investigations, are sometimes lacking in potency or are not standardized. It therefore seems very desirable that the Secretary of Agriculture should be given legal authority to control the importation of such products and to supervise the preparation of those manufactured in this country for interstate commerce, such authority to be similar to that already vested in the United States Public Health and Marine-Hospital Service with regard to similar products for use in human medicine.

The need for legislation to enable the department to regulate more effectively the interstate transportation of live stock so as to prevent the spread of contagious diseases and provide more humane conditions was set forth in my report for the last fiscal year as follows:

> Experience in the enforcement of what is known as the 28-hour law has shown the desirability of exempting in some cases from its operation live stock which is being shipped under quarantine restrictions. Owing to unforeseen delays it is sometimes necessary in order to comply with the law to unload stock which is being shipped under quarantine restrictions into pens which are not specially set apart for that class of stock and which are likely to be used soon afterwards for other stock, and in this way infection has sometimes been spread. This danger could be practically obviated if the Secretary of Agriculture were clothed with power in such cases of emergency to waive the provisions of the law so that animals under quarantine might be kept in the cars for a sufficient time to reach a point where facilities were available for handling them without danger to other stock.
>
> Although existing law authorizes the Secretary of Agriculture to require the disinfection of live-stock cars moving into or out of a section that is quarantined, it is desirable to have this authority extended so as to empower the Secretary of Agriculture to require the disinfection of any live-stock cars

used in interstate commerce whenever he may consider such disinfection necessary in order to prevent the spread of disease.

In the shipment of live stock it is sometimes a practice to put into the same car animals of various sizes and different species, with the result that small animals are often injured or trampled to death by larger ones. In order to remedy this evil it is desirable that the Secretary of Agriculture should have authority to regulate the shipment of different classes of stock in the same cars.

Dead animals are sometimes shipped in the same cars with live ones, and there is danger of the spread of disease in this way. Such shipments should be prohibited by law.

There should also be legislation prohibiting the interstate shipment of young calves, which, on account of their inability to eat solid food and their refusal to drink water, are sometimes kept for several days without nourishment.

## TRICHINÆ IN PORK.

As the bureau continued to receive occasional reports of illness following the eating of uncooked or insufficiently cooked pork, it was found desirable during the year to give to the press a statement warning the public against the danger of trichinosis. An average of about 1 per cent of the hogs slaughtered in the United States are infested with the microscopic parasite commonly known as trichina or fleshworm, the scientific name being *Trichinella spiralis*. When transmitted to human beings trichinæ may cause serious illness, sometimes resulting in death.

No method of inspection has yet been devised by which the presence or absence of trichinæ in pork can be determined with certainty, and the Government meat inspection does not include inspection for this parasite. All persons are accordingly warned not to eat pork, or sausage containing pork, whether it has been officially inspected or not, until after it has been properly cooked.

A temperature of about 160° F. kills the parasite, therefore pork when properly cooked may be eaten without any danger of infection. Fresh pork should be cooked until it becomes white and is no longer red in color in all portions of the piece, at the center as well as near the surface. Dry-salt pork, pickled pork, and smoked pork previously salted or pickled, providing the curing is thorough, are practically safe so far as trichinosis is concerned, but as the thoroughness of the curing is not always certain, such meat should also be cooked before it is eaten.

The bureau has for distribution a circular giving information on the subject.

## PUBLICATIONS AND DIFFUSION OF INFORMATION.

The results of the bureau's work are made available to the people through publications, correspondence, public addresses, and material furnished to teachers, writers, and the press.

The bureau's new publications issued during the fiscal year numbered 105, aggregating 2,891 printed pages. This is an increase of approximately 25 per cent over the preceding fiscal year. In addition to the new publications there have been numerous reprints of earlier publications. The new publications consisted of the Twenty-sixth Annual Report of the Bureau (for 1909), the Annual Report of the Chief of the Bureau for the fiscal year 1910, 22 bulletins, 19 circulars, 7 Farmers' Bulletins, 5 reprints from the annual report, 2 Yearbook articles, 26 orders and amendments, and 22 miscellaneous publications.

In addition to the distribution of literature, it is necessary to conduct a heavy correspondence to meet the large volume of requests for information.

## THE ANIMAL HUSBANDRY DIVISION.

The Animal Husbandry Division, of which Mr. George M. Rommel is chief, deals mainly with the breeding and feeding of live stock and poultry.

### HORSE BREEDING.

#### COLORADO WORK.

The carriage-horse breeding experiments in cooperation with the Colorado Experiment Station have, with one exception, progressed satisfactorily during the past year. The annual culling of inferior individuals is showing its results, and the foals show better quality each year. In August, 1910, the board of survey condemned 8 animals, which were sold at public auction. One mare died during the year; one was destroyed on account of injuries; one foal died, and one was destroyed on account of injuries. The following statement shows the animals in the stud on June 30, 1911:

| Ages. | Stallions. | Mares. | Total. |
|---|---|---|---|
| Aged | 2 | 25 | 27 |
| 4-year-olds | 1 | 5 | 6 |
| 3-year-olds | 3 | 3 | 6 |
| 2-year-olds | 5 | 4 | 9 |
| Yearlings | 11 | 6 | 17 |
| Weanlings | 12 | 5 | 17 |
| Total | 34 | 48 | 82 |

#### IOWA WORK.

In the experiment in the breeding of gray draft horses in cooperation with the Iowa Experiment Station 5 out of 8 mares bred in 1910 dropped foals in 1911, and 4 of these foals are living. Two of these foals are by the Shire stallion Dapple Tom out of Clydesdale mares; the other are by the Clydesdale stallion Kuroki out of Shire mares. Three of the foals are gray in color and one is bay. One

mare was purchased during the year and added to the stud. All the mares are worked regularly on the farm.

VERMONT WORK.

The Morgan horse breeding work at Middlebury, Vt., was enlarged during the year by the purchase of the stud of the Willowmoor Farms at Redmond, Wash. There were 10 mares in the lot, 7 of them of breeding age; of the 7, 6 promise to be excellent brood mares and have been bred to General Gates. The young stock were, with one exception, by the Morgan stallion Troubadour, which attracted so much attention at the live-stock show of the Alaska-Yukon-Pacific Exposition in 1909. One of the 5 young stallions has been castrated. Five of the mares were bred in Vermont, and are good representatives of the old-fashioned Morgan lines, which have proved so valuable in mating with General Gates. The mare Maggie Gates was bought in October, 1910.

The board of survey condemned 4 horses in 1910, which were sold at auction, and 3 condemned weanlings were sold by the Vermont Experiment Station.

The 5-year-old stallion Red Oak has been leased to the Massachusetts Agricultural College, and, although sent to Amherst somewhat late in the season, has received about 20 mares of very good quality. The conditions under which the stallion was leased are of considerable importance, and should be included in this report. The college received the horse f. o. b. Middlebury, Vt., and agreed to keep him in good condition and give him a stipulated amount of exercise daily. The service fees go to the college, but the service fee can not exceed $15. Mares bred must be free from draft blood, free from pacing gait, without manifest defects of conformation such as curby hocks, and free from the following unsoundnesses: Bone spavin, ringbone, sidebone, heaves, stringhalt, lameness of any kind, roaring, periodic ophthalmia, and blindness, partial or complete. It is interesting to note that the college has disqualified almost as many mares as have been bred.

The following statement shows the number of horses on the Morgan Horse Farm on June 30, 1911:

| Ages. | Stallions. | Mares. | Geldings. | Total. |
|---|---|---|---|---|
| Aged | [1] 2 | [2] 22 | [3] 4 | 28 |
| 4-year-olds | ---------- | 3 | [3] 1 | 4 |
| 3-year-olds | 1 | 1 | ---------- | 2 |
| 2-year-olds | 2 | 7 | 1 | 10 |
| Yearlings | 7 | 4 | ---------- | 11 |
| Weanlings | 5 | 5 | ---------- | 10 |
| Total | 17 | 42 | 6 | 65 |

[1] One stallion leased to Massachusetts Agricultural College.
[2] One mare yet to foal.
[3] Work horses.

### ARMY HORSE BREEDING.

Although the desired appropriation for the encouragement of the breeding of horses for the United States Army was not provided by Congress, a small beginning has been made and the plan presented in my last report is being tested experimentally, as described in an earlier part of this report.

### SHEEP AND GOAT INVESTIGATIONS.

The work in Wyoming in breeding range sheep has progressed very satisfactorily during the past year. The ewes gave an 80 per cent crop of good lambs last spring, and those ewes to be carried into the ensuing year sheared 13.1 pounds per head. They stand the range nicely. The 110 yearling ewes which will go into the breeding flock next year are very growthy and strong, and give promise of approaching closely the type sought.

The Southdown flock at the Morgan Horse Farm, Middlebury, Vt., has been maintained at a high standard, and accurate records are being kept of cost of keep and of production. The spring lamb crop was satisfactory.

At the experiment farm at Beltsville, Md., sufficient Barbados ewes have been bred pure to maintain the flock, and the rest have been bred to a Karakul ram, to determine the possibility of producing Afghan skins in the United States.

The Merino-Barbados-Southdown crosses breed at any time of the year, and each cross shows improvement in wool and mutton form.

The native goats were milked after the last kidding and gave fair results.

A few samples of wool have been collected and arranged for display and study.

### CATTLE BREEDING.

#### HOLSTEIN CATTLE.

The work of the Holstein breeding circuit in North Dakota in cooperation with the State experiment station has been conducted along the same lines as heretofore. All the cattle in the circuit were tested with tuberculin during the year, and several herds showed reactions. The reacting cattle are to be disposed of.

A year's record of all cows in the herds was completed January 1, and the approximate cost of production of butter fat determined. Some of the purebred cows produced over 500 pounds of butter during the year. Several heifers have been placed in the Advanced Registry during the year, and all of the more promising cows and heifers will be tested for advanced registry next year.

Seven members of the circuit have built silos during the year, none of whom possessed them before becoming members of the circuit.

The number of purebred Holsteins owned by members of the circuit is 107.

### MILKING SHORTHORNS.

Four herds have been included in the investigations in breeding milking Shorthorn cattle during the past year in cooperation with the Minnesota Experiment Station, and the experiment station bulls were used somewhat during the year in three other herds. The general progress made in the work for the year has consisted mostly in the improvement made by the cooperators in the care and management of the herds. This has resulted in growing the young animals better, and in much improvement in the milk and butter-fat production of the cows on the circuit.

The two sires, Chief of Glenside No. 285899 and Beau of Glenside No. 285898, have been continued in the service. The calves produced by them are developing satisfactorily from the standpoint of conformation. Since no daughters by these sires have come into milk as yet, no knowledge of their ability to transmit their milking inheritance is at hand.

In addition to these two sires, several of their sons, out of approved dams, have been farmed out to prospective cooperators who should be taken into the circuit as soon as they have a sufficient number of females of producing age.

The experiment station and one of the cooperators have purchased jointly the bull Clay Johnson No. 330890, a 3-year-old sire combining meat conformation, Shorthorn character, and milking heredity to a rare degree. This sire has no daughter in milk as yet, but his get are showing up well individually.

All heifers produced by approved dams are being reared. The bulls produced have been disposed of as follows: Those not showing sufficient individual merit, and those out of low-producing dams, have been rejected and castrated. Those from profitable milking dams that developed well individually have been sold to breeders in the usual way. A few from high-producing dams of satisfactory conformation have been reserved to the circuit and used somewhat on other herds.

### ANIMAL BREEDING INVESTIGATIONS.

The research work in animal breeding at the Experiment Station of the bureau near Bethesda, Md., has continued during the year, the most extensive and important investigation being the study of inbreeding in guinea pigs. Twenty-four families are being inbred, matings being made between litter brother and sister in each genera-

tion. All families have been thus inbred for 4 generations and some for 10 generations. The data accumulated for the 4 generations are being compiled for a preliminary report.

The vitality of guinea pigs that have been inbred for 7 generations is being determined by inoculating them with tubercle bacilli. Guinea pigs of equal weight and age, but not inbred, are used as checks. The principals and checks are born and reared in the same building and cared for and treated in exactly the same manner. From results so far obtained it appears that there is no difference in the vitality of the inbred and the normal animals. Before definite conclusions are reached in this matter, however, the experiments must be repeated and large numbers of animals used.

This intense inbreeding is developing in a number of families certain family characteristics which are shown in the color markings, in size of individuals, and in length and texture of the hair. Breeding for the establishing of certain coat-color patterns in guinea pigs has been continued with negative results, as has also an experiment started with the idea of increasing the length of ear in guinea pigs by selection.

Owing to an outbreak of rabies among the white bull terrier dogs they were all destroyed and the work on telegony in which they were used has been discontinued.

## POULTRY INVESTIGATIONS.

### MAIN WORK.

By the plan of selection now being practiced it has been possible to isolate from the flock strains or "blood lines" which are breeding true to definite standards of egg production. There are now being propagated (1) lines having a high winter egg production, (2) lines having a medium degree of winter productiveness, and (3) lines of low winter production. The results of this work are of a definite and clear-cut character.

By the application of Mendelian principles in the work with hybrid poultry it has been possible to combine in one strain the good meat qualities of the Cornish Indian game with the good egg qualities of the Barred Plymouth Rocks, thereby creating a new type regarded as very desirable from the utility standpoint.

### INDEPENDENT INVESTIGATIONS.

During the year the poultry work has been removed from Bethesda, Md., where it was formerly carried on, to the bureau farm at Beltsville, Md. It was deemed inadvisable to move any of the old stock, and this was in consequence marketed. To replace this stock, eggs

were purchased from representative flocks of the following breeds: Barred Plymouth Rock, White Wyandotte, Single-combed Rhode Island Red, Buff Orpington, and Single-comb White Leghorn. Chicks hatched from these eggs are now being raised and will form the foundation stock for the new farm. As a result of the moving and the disposal of the mature stock, no feeding or breeding experiments were carried on during the year.

The investigation of conditions surrounding the handling and marketing of eggs in the Middle West has been continued, mainly in the State of Kansas, and has been very successful. This investigation embraces the study of conditions from the farm to the packing house, experimental work to determine the causes of loss and deterioration, and the encouragement of the use of the "loss-off" system of buying eggs. As a result of the efforts of the bureau in Kansas in cooperation with the State authorities, neighboring States are becoming interested in the movement for better eggs.

A careful study has been made of the commercial feeding or fattening of poultry, particularly milk fattening, in this same area. Detailed figures of the gain, cost of gain, amount of grain per pound of gain, etc., have been obtained for over 30,000 birds. The figures, therefore, are believed to be very reliable.

Some attention has been given to the encouragement of marketing eggs through the creameries. Several creameries are now handling the eggs produced on the farms of their patrons with good success. Other creameries have indicated their intention of starting such a system of handling eggs in the near future.

### ANIMAL NUTRITION INVESTIGATIONS.

During the fiscal year the work in animal nutrition in cooperation with the Pennsylvania State College has consisted largely in a thorough revision and testing of the respiration calorimeter, together with the addition of certain improvements designed to secure more detailed and accurate results. These improvements include appliances for the determination of the excretion of carbon dioxid and water in the standing and lying positions, respectively, an additional electrical furnace for the determination of methane, and repairs to the refrigerating machine. Additional laboratory equipment has also been procured, which will conduce to the rapidity and economy of the work.

During the fiscal year 1911–12 it is planned to make a comparative study of the effects of standing and lying upon heat production and upon the excretion of carbon dioxid, and also to continue the determinations of the energy values of feeding stuffs.

### BEEF PRODUCTION INVESTIGATIONS.

The beef production investigations carried on through the Alabama Experiment Station with two large landowners in Sumter County, Ala., are progressing in a highly satisfactory manner. Every phase of the cattle industry under those conditions is being studied, and results are being obtained which, it is believed, will be of great value to the South. The fact that cattle can be fed profitably in Alabama in summer has been demonstrated by the officers in charge of this work. It is fortunate that the work is so well advanced that by the time the pastures of western Alabama are free from ticks and the cotton boll weevil reaches that section data of a comprehensive and accurate nature will be available to show those farmers desiring to embark in the cattle business how it should be conducted to be profitable.

### PORK PRODUCTION INVESTIGATIONS.

The pork production investigations, conducted under similar conditions in Sumter County, Ala., are also yielding encouraging results. The farm on which the work is done is now on a profitable basis, and it is believed that it will become more profitable as time goes on.

### CERTIFICATION OF PURITY OF BREEDING OF IMPORTED ANIMALS.

Since January 1, 1911, the department has exercised the power given to it under the provisions of paragraph 492 of the tariff act of August 5, 1909, to pass upon the sufficiency of the pedigree certificates of animals imported for breeding purposes, instead of delegating this function to certified American pedigree record associations, as has been the policy heretofore.

From January 1, 1911, to June 30, 1911, inclusive, there were imported 1,171 horses, 1,427 cattle, 12 sheep, 7 hogs, 190 dogs, and 12 cats, for which certificates of pure breeding have been issued by this bureau.

In connection with the examination of certificates the animals are inspected at the port of entry to see that the animals and certificates agree in description. During the first six months of the calendar year 33 certificates for horses have been returned to the importers on account of the animals not agreeing with the certificates. There have also been returned to the secretaries of the foreign breeders' societies for correction 23 certificates for horses, 20 for cattle, 2 for sheep, and 2 for dogs. Pamphlets are issued quarterly or at other intervals giving the names and registry numbers of the imported animals, names of importers, and the dates of importation.

### THE EXPERIMENT FARM.

The work at the experiment farm of the bureau near Beltsville, Md., has been devoted almost entirely to putting the farm into condition for experimental work. A dog-tight 58-inch woven-wire fence is being built around the farm, fields and paddocks are being fenced, and a road and lanes constructed. A tool and implement shed has been built, and the superintendent's dwelling repaired and the interior painted and papered. A hog house, a poultry house, and a building for the research work in animal breeding are being erected, and numerous small portable houses built. The land has been cleared and plowed. Thirty-five acres are in corn and 100 acres in cowpeas. All tillable land is being broken up and put into some kind of crop.

The equine stock, the sheep, and the goats have been transferred from the Bethesda Experiment Station, and the guinea pigs and other small experimental animals will be moved as soon as quarters are available. Two purebred Percheron mares, 2 years old, were purchased in June, and a small herd of grade Berkshire pigs has been started.

### PLANS FOR 1912.

Among the plans for 1912, worthy of note in this place, may be mentioned the following:

(1) It is proposed to begin preparations to make an exhibit of the horses bred at the Colorado Experiment Station, and the Morgan horse farm, at the larger live-stock shows of 1912.

(2) In order to encourage farmers of Vermont, especially those near the Morgan horse farm, to breed to the stallions kept there, it is proposed to stand the stallions during the season of 1912 without charge for service fees, the owner of a mare to agree in return to give to the United States at an agreed price an option on the resulting foal during the year it is 3 years old. Mares must be registered in the Morgan Register, free from pacing gait, of good conformation, and sound. In this way the breeding of high-class horses in the State can be encouraged, information as to promising fillies can be obtained, and any branch of the Government, including the Army, may avail itself of the option.

(3) A collection of samples of wool will be begun during the year, designed to show the characteristics of the classifications at various markets, and a study of the relation between quality in fleece and in the finished cloth will also be undertaken if suitable arrangements can be made.

Some ewes of the long-wool breeds, with fleeces of high luster and free from excessive grease, will be purchased to breed to the Karakul

buck, for the study of the possibility of growing "Persian lamb" in the United States.

An exhibition of sheep bred by the department in the Wyoming project will be made at two live-stock shows of 1911.

Other projects will be carried on practically as during the past year, with due allowances for natural growth.

## THE DAIRY DIVISION.

The work of the bureau relating to the dairy industry comes under the Dairy Division, of which Mr. B. H. Rawl is chief.

### DAIRY FARMING INVESTIGATIONS.

The principal lines of dairy farming investigations, in charge of Mr. Helmer Rabild, are southern dairying, western dairying, cow-testing associations, and experimental work.

#### SOUTHERN DAIRYING.

The educational work for the development of dairying in the Southern States is progressing along the same lines as in previous years and includes herd improvement, economical feeding, the building of barns, silos, dairy houses, and ice houses, the creation of interest in dairy organizations, the improvement of city milk supplies, the conduct of short courses in dairying, operating model dairies and making dairy exhibits at fairs, the supervision of butter contests at fairs, work with creamery patrons, etc. The work is in progress in Alabama, Tennessee, Georgia, Mississippi, North Carolina, South Carolina, Texas, Virginia, Maryland, and the District of Columbia. The work in Maryland was begun May 1, 1911. It is the policy of the department to work in cooperation with State authorities or institutions and to turn the work over to these agencies when they are prepared to carry it on alone. During the past year the assistance previously given in North Carolina was withdrawn because the work there no longer needed help from the department. The work in Tennessee has been temporarily suspended until State cooperation can be arranged for.

For the past few years the Dairy Division has managed a demonstration dairy farm near Denison, Tex., owned by the Denison Board of Trade. That the improvement of the herd on this farm has been very marked is indicated by the fact that the average production of butter fat per cow has been increased 55 pounds during the past year. Although the work of the farm has been hampered by drought during the past two years, it is still hoped it will yet serve fully the object for which it is being conducted, namely, to demonstrate a successful and profitable dairy farm in that section.

Frequently promoters attempt to build and sell creameries in various parts of the Southern States, the people of the community being induced to furnish the capital. The Dairy Division advises against this in localities where conditions appear to be such as to make it impossible for a creamery to be operated successfully. Of seven creameries promoted in Georgia two years ago against the division's advice six have been closed and the other is being operated at a loss. It is very important that creameries should not be built under unfavorable conditions, since the failure of a creamery gives the dairy industry a great setback in the adjacent community.

WESTERN DAIRYING.

The work for the development of dairying in the Western States is conducted along the same general lines as that in the South. It is at present carried on in Colorado, Idaho, North Dakota, and Iowa. The results indicate that the West offers a most favorable field for this work, which it is believed will be the means of starting work in the various States which in time will become an important factor in developing the dairy industry in that section. Splendid opportunities for dairying are found in Idaho, where during the past year alfalfa sold as low as $1.25 a ton, the average being $3. An opportunity is offered there to give the farmers assistance in securing cattle to consume this alfalfa at a much better profit. Opportunities quite similar have been found in Colorado and other Western States, where in the past the farmers have devoted their attention largely to range cattle, and therefore often know practically nothing of scientific dairying. The reduced ranges and the increased prices of land are factors that make dairying a very much more important part of the agriculture of that section than it has been in the past. The great number of mistakes commonly committed indicate the lack of knowledge of economical dairy practice. By demonstrating such practice on a few of the dairy farms, sufficient public sentiment is being created to enable the States to secure funds to take up this work. In fact, some assistance is already being given by all the States in which extension work by the department is now in progress. The department's work in the West can be extended to excellent advantage if more funds are provided for it. At least one man should be assigned to each of the States west of Kansas and Nebraska and also in the Dakotas.

COW-TESTING ASSOCIATIONS.

Two men have been engaged in giving assistance to State officials in organizing and conducting cow-testing associations. This work has been described in previous reports. During the past fiscal year 33 new associations were formed and 7 were discontinued. At present there are 81 associations in the United States, the greater number of

which the Dairy Division has been instrumental in organizing. The plan in organizing is to require local officers to assume responsibility for conducting the organization. When necessary, assistance is given in maintaining these associations by sending a man to straighten out difficulties that arise. These 81 associations comprise about 40,000 cows. The following results in two herds of one of the associations are an interesting example of what is being accomplished in enabling farmers to keep records of cost, production, etc., and to detect and remedy any shortcomings:

*Comparison of averages of two herds in same association.*

| Herd. | Number of cows. | Milk. | Fat. | Value of fat. | Roughage. | Grain. | Cost of feed. | Net profit. | Cost of 1 pound butter fat. |
|---|---|---|---|---|---|---|---|---|---|
| | | *Pounds.* | *Pounds.* | | *Pounds.* | *Pounds.* | | | |
| 1 | 7 | 9,207.6 | 392.7 | $127.26 | 8,913 | 1,914 | $51.04 | $76.22 | $0.129 |
| 2 | 8 | 5,482.1 | 198.9 | 63.86 | 5,555 | 1,968 | 55.21 | 8.65 | .277 |

One of these herds made a profit of $76.22 per cow, while the other made a profit of only $8.65 per cow. The more profitable herd was fed an abundance of silage, while to the other no silage was fed. This, of course, is not the only reason for the difference; however, a careful study of the records of these herds indicates that silage is very essential to the maintenance of a full milk flow during the winter months. The owner of the unprofitable herd has been living next to a man who had a silo for a number of years, yet he did not realize its usefulness until he saw these figures, after which he built a silo at once.

Plans have been prepared for the organization of several bull associations for the purpose of enabling the owners of several small herds to cooperate in securing better bulls.

### HERD RECORDS.

The practice of keeping records of single herds separately is urged only where cow-testing associations can not be organized. Herds containing 1,174 cows have been included in this work during the past year. From one herd, as a result of this work, 25 unprofitable cows were sold. In another herd, by change of feed, the cost of feeding per cow was reduced from $6.52 to $5.48 per month. In still another the cost of feed was reduced from $6.05 to $4.63 by the same means. The use of purebred bulls follows as a natural result of any kind of herd-record work.

### DAIRY BUILDINGS.

Blue prints have been furnished to farmers during the year for 236 barns, 113 silos, 124 milk houses, 45 ice houses, 8 dairy schools, 5 manure sheds, and 105 miscellaneous structures. This work has been received with much appreciation by the farmers, and the bureau has been obliged to refuse many requests for plans to suit specific requirements, also for plans for peculiar conditions in the West, owing to the pressure of work.

Assistance has been given during the year in the erection of 140 silos, 36 of which were of concrete reenforced with wire fencing, 1 was of metal lath and cement, 2 were of brick, and the rest of wood, either stave or modified Wisconsin type. This work of encouraging the use of silos is very fruitful. The advantage of using silage is well recognized; still the average dairyman is inclined to regard the silo as an experimental venture until he has seen one used successfully. Therefore, whenever one silo is built in a community where there are none, others are usually built later.

### EXPERIMENTAL WORK.

During the spring an experiment was made, in cooperation with the Bureau of Plant Industry, in feeding to a herd of dairy cattle at Wiley, Va., an extract made from cornstalks in the process of paper manufacture, for the purpose of determining the value of this extract as a feed. It was not possible to make the experiment comprehensive and complete, but it was intended as a preliminary investigation to determine in a general way whether or not some value could be assigned to this by-product as feed for dairy cattle. The substance showed no deleterious effect on the cattle, and in a general way appeared to have a value of not less than $9 a ton as compared with other feeds at current prices. More comprehensive investigation may indicate a greater value.

### MARKET MILK INVESTIGATIONS.

The work of market milk investigations, of which Mr. George M. Whitaker is in charge, is largely educational in character with a view to improving local milk conditions, and is carried on mainly in cooperation with city health departments. During the year this work has included 51 cities in 27 States. This number does not include suburban places adjoining large cities in which a considerable work has been done. The chief lines of work have been introducing and carrying out the score-card system of inspection, assisting in competitive exhibitions of milk and cream, inspecting the milk supply placed on sale in the Government departments, and investigating the conditions of the milk business in the vicinity of Boston.

In the introduction of the score-card system and the giving of assistance in properly carrying it out, 620 inspections were made in 24 States. These inspections were made in company with either the health officer or one of his inspectors.

A number of States and municipalities that have had inadequate laws have, partly because of the department's work, enacted laws to provide suitably for milk inspection.

The importance of work such as is being done by the department in assisting city health authorities to improve the milk supply is shown by the fact that a large proportion of the deaths of young children in cities is undoubtedly due to bad milk. Great improvement has been brought about in some cities, but in many cases there are serious obstacles to progress, such as political conditions and the ignorance of milk consumers. One of the most important things in milk inspection is the employment by the cities of properly qualified inspectors who are capable of educating the farmers and the public.

The bureau assisted in nine competitive milk exhibitions during the year. These contests serve a useful purpose in educating the consumers as well as the producers of milk.

During the past year a system of inspection and permits for milk sold in the Department of Agriculture was established. When this became known, the Departments of Commerce and Labor, Interior, Treasury, State, War, and Navy requested the assistance of this department in introducing and carrying on similar inspection in those departments. The Dairy Division is conducting this inspection, in cooperation with the chief clerks of the respective departments. Only seven dealers are now permitted to sell milk in these departments. Eleven others that have at one time or another had permits have been refused a continuation of these permits because of the inferior quality of their product. It is believed that this inspection is serving a useful purpose, not only in protecting the employees, but in establishing a precedent that may be helpful to the general milk inspection of this and other cities.

A special investigation of the milk business in Boston and vicinity was begun late in the fiscal year, in cooperation with the health officials of that city, and is still under way.

### DAIRY MANUFACTURING INVESTIGATIONS.

The work relating to dairy manufactures, in charge of Mr. S. C. Thompson, includes the inspection of butter, assistance in the management of creameries and other dairy manufacturing enterprises, and the study of processes and products from the commercial standpoint.

MARKET INSPECTION OF BUTTER.

The market inspection of butter has been continued, 2,723 inspections having been made at Chicago, 2,505 at New York, and 126 at San Francisco, a total of 5,354. This is an increase of about 75 per cent over the previous year, which indicates that the work is regarded with increasing favor by the trade. This inspection is made at the request of the dealer or the producer, and defects in the butter are pointed out and suggestions made for remedying them.

CREAMERY MANAGEMENT.

Field men located in Wisconsin, Minnesota, Iowa, California, and Texas have given assistance to creameries with a view to improving their efficiency. One thousand three hundred creameries have made reports to the Dairy Division, showing amount of butter fat received, amount of butter made, prices received for butter, and prices paid to the farmers for butter fat. In this way a large number of defects in creamery operation are detected and corrected, either by correspondence or by personal attention of the field men. During the year 74 creameries received personal attention from the field men.

A large quantity of low-grade butter is still being produced, as is indicated by the reports of market inspectors. Of 2,161 shipments of butter from Minnesota, Wisconsin, and Iowa, only 277, or about 12.8 per cent, graded "extras." This indicates that there is much need of improvement in quality of cream used by the creameries and also in the workmanship in the creameries.

All encouragement possible has been given to the practice of grading cream, so that a first-class cream may be separated from the inferior cream and paid for according to quality. Twenty-eight creameries, located in 9 different States, report that they are grading their cream with good results. An experiment, begun early in the winter of 1910, is being conducted at the Algona, Iowa, creamery for the purpose of determining whether or not the farmers can be induced to supply a high grade of cream that will sell for an extra price. The cream is being graded, the first grade containing less than 0.2 per cent of lactic acid, and the second grade containing more than this proportion. At first the bulk of the cream went into the second grade. At present more than two-thirds of it is first grade and is sold for a premium of about 5 cents per pound of butter. This work is being conducted in cooperation with the State dairy commissioner of Iowa and with the professor of dairying at the Iowa State College of Agriculture. The main object sought is to ascertain whether or not it would be profitable for creameries to conduct similar educational work at their own expense. So far the results of this work have been satisfactory, and it is proposed to continue it.

The work of assisting in the organization of new creameries by furnishing articles of agreement, by-laws, lists of machinery, etc., has been continued. Care is exercised to give this assistance only in localities where creameries are justified by conditions.

Creameries are encouraged to pay more attention to what may be called "side lines" for the utilization of their by-products, and 453 creameries are known to follow such a practice. Some of the most important of these "side lines" are feeding buttermilk to hogs, making ice cream, manufacturing ice, shipping sweet cream, and handling eggs.

### HARVESTING AND STORING ICE.

A very large proportion of the dairymen of the United States can have natural ice at a very small cost if they can be taught the necessity of it. In the main the bad cream received at the creameries is due to dirt and heat, and the bad milk in cities is largely due to the same causes. The Dairy Division is therefore doing what it can to encourage the storage and use of natural ice. An investigation has been made in the New England States relative to the most practicable methods of harvesting and storing ice for dairy use, and information on this subject is being prepared for publication.

### INSPECTION OF BUTTER FOR THE NAVY.

The Dairy Division has continued its inspection of butter for the Navy. Between April 5 and August 15, 1910, 702,000 pounds of butter was thus inspected, and similar inspection was carried out in 1911. When this inspection was begun the quality of the butter which was being received was invariably below the grade called for in the contract. The inspectors have consistently rejected all such butter, and in this way a considerable sum has been saved to the Government. In New York, for example, 238,000 pounds of butter was examined, of which 82,000 pounds was rejected.

### RENOVATED BUTTER INSPECTION.

The inspection of renovated or "process" butter and of the factories where it is produced is carried on under the act of Congress of May 9, 1902, and is under the direction of Mr. Robert McAdam. The Dairy Division is assisted in this work by some of the members of the meat-inspection force of the Inspection Division. The bureau cooperates with the revenue officers of the Treasury Department, especially by making moisture tests and notifying those officials when butter is found containing moisture in excess of the legal limit of 16 per cent.

There are 38 bonded factories producing renovated butter, a few of which operate very irregularly. The total amount of renovated

butter produced during the fiscal year was 41,115,058 pounds, a decrease of 5,799,436 pounds as compared with 1910. The exports amounted to 118,990 pounds, an increase of 87,140 pounds.

The present law is not entirely satisfactory and does not give sufficient authority for proper inspection. A recommendation for the amendment of this law has been made, and it is hoped that the needed authority may be granted. Many of the manufacturers are endeavoring to make as good a quality of butter as possible, and with their cooperation it has been possible to bring about improvements in the sanitary condition of factories even though there was doubt as to the department's power to enforce such measures. Under the present law the use of the word "renovated" has been almost entirely abandoned by the manufacturers, and the term "process butter" is used almost exclusively, thus giving rise to much deception.

## RESEARCH LABORATORIES.

The dairy research laboratories, in charge of Mr. L. A. Rogers, have been engaged upon various chemical and bacteriological problems in connection with milk, butter, and cheese. The work on milk and butter is carried on at the central laboratory at Washington and the field laboratory at Troy, Pa. The chemical and bacteriological work on the Swiss type of cheese is carried on at Washington, and the cheese making is done at the Pennsylvania State College in cooperation with that institution. The Cheddar cheese work is conducted at Madison, Wis., in cooperation with the Agricultural Experiment Station of the University of Wisconsin; and the Roquefort cheese work at Storrs, Conn., in cooperation with the Storrs Agricultural Experiment Station. The investigations on milk secretion are carried on at Columbia, Mo., in cooperation with the Experiment Station of the University of Missouri.

At the close of the butter-making season of 1910 conditions had become such that it was necessary to suspend the work at Albert Lea, Minn., where a field laboratory of the Dairy Division had been operated in connection with the creamery of the Albert Lea Dairy Association. Arrangements of a tentative nature were made with the Pennsylvania State College for the Swiss cheese work. The field laboratory and experimental butter-making work have been established at Troy, Pa., through a contract with the Troy Creamery Co. This arrangement provides the bureau with laboratory space in a new creamery of modern design and construction. Under the contract the bureau has entire control of the operation of the creamery, without responsibility for the financial side of the business beyond the cost of manufacture. This will make it possible to carry on investigations in the management and operation of a large creamery, in

addition to the more technical work in butter making. The Troy creamery is easily accessible from Washington, thus increasing the efficiency of the field laboratory without adding to the expense of operation.

MILK INVESTIGATIONS.

The milk investigations have included a continuation of the work of the previous year in studying the bacteria of pasteurized and raw milk. The results of this study were published as Bulletin 126 of the bureau. One of the most interesting facts brought out by this work is that pasteurized milk ordinarily does not decompose, as it is generally supposed to do, but sours in a normal way. While this work was not sufficiently extensive to warrant final conclusions, it indicates very strongly that pasteurized milk often contains a higher percentage of lactic-acid-forming bacteria in comparison with other forms of bacteria than raw milk does. In this connection 300 cultures were examined for fermentative ability, and a new medium has been developed which promises to be of much value in milk work. This study has also included the bacteria which produce alkalinity in milk.

The subjects of buttermilk and whey as by-products are under investigation, and the production of an excellent massage cream by means of separating the curds from buttermilk has resulted. It has been found that an active culture of *Bacillus bulgaricus* is capable of converting nearly all the milk sugar in whey into lactic acid. This is particularly interesting since about 10,000,000 pounds of lactic acid, valued at $158,000, was made from glucose in this country in 1905.

Chemical work in connection with this investigation has supplied some exact information on the subject of chemical changes in milk due to pasteurization. This study has developed some interesting results pertaining to the proteids most likely to be coagulated by heat. Milk heated for 30 minutes to 145° F. showed no change. At 150° F., 5 per cent of the albumin and globulin were precipitated. At 155° F., 12 per cent of these were precipitated, and at 160° F., 30 per cent. Similar results have been obtained relative to changes in the ash and in determining the time required for coagulation with rennet. In the latter case milk heated to 150° F. for 30 minutes showed no change in the time required for coagulation, but when heated to 176° F. for 30 minutes the time of coagulation was increased threefold. Milk pasteurized at 145° F. is therefore free from the objection sometimes urged against pasteurization because of the alleged precipitation of albumin. This objection applies only when the milk is heated to an unnecessarily high temperature.

About 150 samples of goat's milk have been analyzed for moisture, fats, and solids, opportunity being afforded to make these analyses on milk furnished by the Animal Husbandry Division.

The investigation relating to lactic-acid bacteria is complete and the results are being prepared for publication. This investigation has established the possibility of separating this group into distinct and well-defined subordinate groups. An investigation of the gas-forming bacteria in milk is under way.

In the milk-secretion investigations carried on at Columbia, Mo., in cooperation with the Experiment Station of the University of Missouri, the principal lines of work for the past year have been:

(1) The influence of the plane of nutrition on the composition and properties of milk. The plan followed was to keep certain cows on maintenance rations for a period, then to feed them on a ration that supplied less nutriment than the amount necessary to maintain the body and support the milk production. The animals were then gradually brought back to the maintenance ration, and finally fed an excessive amount of feed, causing a deposition of fat on the body. These variations in the plane of nutrition were tried several times on the same animals. The experimental part of this investigation is completed, but the data have not been prepared for publication. The results secured are believed to be of considerable importance and bring to light new factors that will have to be taken into account in the future as causes of variation in the composition of milk.

(2) The effect of cotton seed, cottonseed meal, and cottonseed hulls on the composition and properties of milk. Three phases of the problem have received special consideration, namely, (*a*) the effect of the amount fed; (*b*) the effect of the kind of supplementary feeds used with the cottonseed meal; (*c*) the effect of adding lime to the ration. Considerable data have been obtained, but the investigation has not been completed.

(3) A study of the coloring matter of butter. Further work has been done on the isolation and identification of the lipochrome, or natural coloring matter of butter, but the work is not yet completed.

(4) The preservation of milk samples for analysis. A thorough study of the efficiency of certain chemicals as milk preservatives, and the best conditions, such as the temperature and the container, etc., for preserving milk, has been in progress all the year. This work is nearly completed.

The investigations that are still incomplete will receive first consideration, and will be finished during the coming year, if possible. It is also planned to study the effect of cotton seed, cottonseed meal, and cottonseed hulls on the market value of butter.

### CHEESE INVESTIGATIONS.

SWISS CHEESE.—The work on the Swiss type of cheese has been considerably handicapped by the moving of the laboratory from

Albert Lea, Minn. It has been found, however, that cheese without gas holes other than the usual "eyes" can be made from very gassy milk by the use of the so-called *Bacillus bulgaricus* starter of exceptional activity, ordinary cultures of this organism failing to produce the same results. A study of the bacterial flora of imported and domestic Swiss cheese showed that after the initial period the bacteria consisted almost exclusively of two varieties of the *B. bulgaricus* type. This fact has an important bearing on these investigations.

The chemical work in connection with Swiss cheese has established the fact that the first proteolytic change in ripening Swiss cheese is the formation of substances soluble in salt solution. A method for collecting the gases from the eyes of Swiss cheese has been worked out, and the apparatus for this determination constructed. The study of pasteurization of milk for Swiss cheese making is being continued.

CHEDDAR CHEESE.—The work relating to the Cheddar type of cheese has continued about as in the past. The use of hydrochloric acid in the manufacture of Cheddar cheese from pasteurized milk has been continued. The following points in this connection are being investigated:

(1) The practicability of this method in the hands of experienced cheese makers.

(2) The possibility of applying the method daily throughout the year to all sorts of milk which may lawfully be used for cheese making in Wisconsin.

(3) The precautions to be taken in the use of this method.

(4) Whether the curing of pasteurized-milk cheese can be safely conducted at a higher temperature than that of raw-milk cheese.

(5) The suitability of this cheese for various markets.

(6) The loss in weight during shipment and sale of cheese in the South.

(7) The relative quality of raw-milk cheese and pasteurized-milk cheese made from the same milk supply.

(8) The cost of pasteurization and the cost of manufacture when pasteurized milk is used, as compared with the same costs when raw milk is used.

It is hoped to establish standard methods of cheese making whereby the milk can be brought into uniform condition from day to day, and thus to make it possible to manufacture a uniform article.

The bacteriological work in connection with this line of investigation has been a continuation of the study of the forms of bacteria important in the manufacture of Cheddar cheese. Specific cultures have been isolated from cheese made of raw and of pasteurized milk,

and these cultures have been studied, considerable attention being given to the high acid-producing bacteria found in cheese. Chemical work to a considerable extent has been devoted to the nonnitrogenous constituents of good and poor cheese at different stages of ripening.

SOFT CHEESE.—The work on the Roquefort variety of cheese has comprised the investigation of (1) the chemical composition of Roquefort cheese and the establishment of a standard for this variety as compared with other varieties; (2) the chemical changes taking place in the process of ripening; (3) the effect of salt on the ripening process; (4) the method of handling the Roquefort mold powder used in inoculating the cheese; (5) the effect of lactic-acid starters in manufacturing this variety; (6) the water content and its relation to the proper ripening of the cheese.

Chemical work in connection with these investigations was devoted to an investigation of the water content at various stages of ripening, the means of controlling it, the relation of acid in the milk to the quality of the cheese, and methods of salting and handling the cheese during the process of ripening.

There are various minor problems under investigation in connection with the work on soft cheese. These investigations develop results rather slowly, because there has been so little experimental work done along this line and because there are so many questions that demand study. This work is being conducted in a thorough and comprehensive manner, and this requires much time and work. However, one by one the questions involved are becoming understood, and it is hoped that in time this work will supply knowledge that will serve as a basis upon which a profitable soft-cheese industry may be established in America.

### BUTTER INVESTIGATIONS.

The work pertaining to changes in storage butter has been continued with some progress. The effect of metallic salts on cream has been studied, with the result that 20 parts of a metal salt in a million parts of cream show a distinct influence on the flavor of the butter, copper being more active than iron. These investigations have already shown that deleterious effects were obtained when acid cream was used. More recently it has been found that when oxygen is run through a flask of milk containing metal salts a strong odor is produced in a short time. All these facts support the hypothesis that the principal changes in storage butter are due to the catalytic action of metal salts produced by the action of acid cream on cans, vats, and other containers in inducing an oxidation of some constituent of the butter. This hypothesis can not be definitely established as yet,

but recent results are very encouraging. A method has been perfected for measuring the gases in butter, and by this means it is hoped that oxidation can be measured.

An effort has been made to establish a method of determining lime in butter when used as a neutralizing agent.

For the purpose of establishing the normal composition of creamery butter, upon which more satisfactory standards may be based, about 1,000 samples of butter have been analyzed during the year.

During the past season butter made from unpasteurized ripened cream (the usual method), from pasteurized ripened cream, and from pasteurized sweet cream was stored and compared, and the results again showed the superior keeping qualities of that made from pasteurized sweet cream. This butter was free from fishy or other storage flavor. The results are summarized in the following table:

*Comparison of storage butter made by different methods.*

| Method. | Initial score (average). | Storage temperature. | Score after storage (average). |
|---|---|---|---|
| | | °F. | |
| Raw cream, ripened | 92.4 | 0 | 87.3 |
| | | 10 | 86.9 |
| | | 20 | 86.3 |
| Pasteurized cream, ripened | 93.4 | 0 | 91.2 |
| | | 10 | 90.3 |
| | | 20 | 88.3 |
| Pasteurized cream, sweet | 92.9 | 0 | 92.4 |
| | | 10 | 91.9 |
| | | 20 | 91.4 |

In studying the relative cost of making butter from pasteurized and unpasteurized cream the results indicate that no more coal is used in making it from the pasteurized than from the raw cream, and the difference in ice is comparatively small.

The investigations looking to the production of dried cultures for use in butter and cheese making have been handicapped by the fact that a patented process is involved; but aside from this process it has been found possible to produce dried cultures containing 50,000,000 cells per gram, and this is a very great improvement over the cultures usually found on the market. This work will be continued and will be extended to include a study of the loss of vitality in cultures after drying.

## DAIRY ENGINEERING.

Work on various engineering problems pertaining to the dairy industry has been continued. Particular attention has been given to dairy buildings, equipment, machinery, etc. During the past year the services of an expert engineer have been obtained to conduct

investigations pertaining to cold storage. There is little scientific information on the general subject of cold storage, and practically none that applies especially to dairy problems. In many phases of the dairy business cold storage is a tremendous factor, and the most economical methods of applying it are of great importance. It is hoped that this work will develop some improved methods in the shipping of milk.

### THE BELTSVILLE FARM.

The portion of the bureau's experiment farm at Beltsville, Md., set aside for the Dairy Division, amounting to 185.7 acres, is now under cultivation. The principal work done on the farm so far has been in connection with putting the fields into condition for cultivation. Most of the land has been freed from stumps, the ditches have been straightened, and the place is being rapidly brought into a good state of cultivation. Two concrete silos have been built and a feed barn of monolithic concrete has been begun. One wing of the barn will be built as an open cattle shed and the other will be the ordinary type of cow stable, thus giving an opportunity to compare the two systems of housing dairy cattle. It is proposed to buy a small herd of dairy cattle for experimental purposes.

## THE INSPECTION DIVISION.

The work of the Inspection Division, in charge of Dr. R. P. Steddom, chief, consists of the meat inspection and the control and eradication of contagious diseases of animals.

### THE MEAT INSPECTION.

The meat-inspection work of the year shows an increase over the preceding year in the number of animals slaughtered, in the amount of meat food products prepared, and in the amount of meat and meat food products exported.

Inspection was conducted during the fiscal year at 936 establishments located in 255 cities and towns, as compared with 919 establishments in 237 cities and towns during the fiscal year 1910.

Inspection was inaugurated at 108 establishments and was withdrawn from 78 establishments during the year, as compared with 105 and 91 establishments, respectively, during the fiscal year 1910. In 68 cases the cause of withdrawal was that the establishments discontinued slaughtering or interstate or regular business; in 6 cases withdrawal was due to insanitary conditions, failure to meet requirements of the department, or to violation of the regulations; while in 4 cases the inspection was withdrawn by request.

The following statement shows the number of establishments and the number of cities and towns where the inspection of meat and

meat food products has been conducted by the bureau in each fiscal year, beginning with 1891:

*Number of establishments and number of cities and towns where meat inspection has been conducted, fiscal years 1891 to 1911, inclusive.*

| Years. | Establishments. | Cities and towns. | Years. | Establishments. | Cities and towns. | Years. | Establishments. | Cities and towns. |
|---|---|---|---|---|---|---|---|---|
| 1891 | 9 | 6 | 1898 | 135 | 35 | 1905 | 151 | 52 |
| 1892 | 23 | 12 | 1899 | 139 | 42 | 1906 | 163 | 58 |
| 1893 | 37 | 16 | 1900 | 149 | 46 | 1907 | 708 | 186 |
| 1894 | 46 | 17 | 1901 | 157 | 52 | 1908 | 787 | 211 |
| 1895 | 55 | 19 | 1902 | 155 | 50 | 1909 | 876 | 240 |
| 1896 | 102 | 26 | 1903 | 156 | 50 | 1910 | 919 | 237 |
| 1897 | 128 | 33 | 1904 | 152 | 51 | 1911 | 936 | 255 |

During the fiscal year market inspection was extended to 2 more cities, making a total of 41 cities at whose public markets Federal meat inspection is conducted in order that interstate deliveries may be made without violating the meat-inspection law and regulations.

ANTE-MORTEM INSPECTIONS.

The number of animals of each species inspected before slaughter is given in the following statement, which shows an increase in the number of sheep and swine inspected and a decrease in the number of cattle, calves, and goats inspected, making the total ante-mortem inspections 7.5 per cent greater than for the previous year:

*Ante-mortem inspections of animals, fiscal year 1911.*

| Kind of animals. | Passed. | Suspected.[1] | Total inspected. |
|---|---|---|---|
| Cattle | 7,762,473 | 45,239 | 7,807,712 |
| Calves | 2,211,187 | 2,940 | 2,214,127 |
| Sheep | 13,001,932 | 3,890 | 13,005,822 |
| Goats | 54,373 | 9 | 54,382 |
| Swine | 29,892,489 | 27,772 | 29,920,261 |
| Total | 52,922,454 | 79,850 | 53,002,304 |

[1] This term is used to designate animals found or suspected of being unfit for food on ante-mortem inspection, most of which are afterwards slaughtered under special supervision, the final disposition being determined on post-mortem inspection.

POST-MORTEM INSPECTIONS.

The inspections made at the time of slaughter are given in the following statement, which shows an increase of 7.7 per cent over the fiscal year 1910. As in the case of ante-mortem inspections, the increase was in the number of sheep and swine, while the other species show a decrease. Although over 2,000,000 more hogs were slaughtered than in 1910, the number was 12.4 per cent less than the average for the fiscal years 1907, 1908, and 1909.

*Post-mortem inspections, fiscal year 1911.*

| Kind of animals. | Passed for food. | Passed for lard and tallow only. | Condemned. | Total. |
|---|---|---|---|---|
| Cattle | 7,738,452 | 3,176 | 39,402 | 7,781,030 |
| Calves | 2,212,252 | 2 | 7,654 | 2,219,908 |
| Sheep | 12,994,681 | 32 | 10,789 | 13,005,502 |
| Goats | 54,084 | ..... | 61 | 54,145 |
| Swine | 29,777,386 | 79,500 | 59,477 | 29,916,363 |
| Total | 52,776,855 | 82,710 | 117,383 | 52,976,948 |

In the foregoing table are included the post-mortem inspections of the carcasses of animals "suspected" on ante-mortem inspection, the final inspections of carcasses that were "retained"[1] at the time of slaughter, and the carcasses of animals slaughtered without ante-mortem inspection and presented to official establishments with the head and viscera attached.

The various diseases and conditions for which fresh carcasses and parts were condemned and tanked are shown in the following table:

*Diseases and conditions for which condemnations were made on post-mortem inspection, fiscal year 1911.*

| Causes of condemnation. | Cattle. | | Calves. | | Swine. | | Sheep. | | Goats. |
|---|---|---|---|---|---|---|---|---|---|
| | Carcasses. | Parts. | Carcasses. | Parts. | Carcasses. | Parts. | Carcasses. | Parts. | |
| Tuberculosis | 27,186 | 49,262 | 204 | 131 | 31,517 | 870,361 | 1 | ..... | ..... |
| Actinomycosis | 547 | 60,696 | 26 | 180 | ..... | ..... | ..... | ..... | ..... |
| Caseous lymphadenitis | ..... | ..... | ..... | ..... | ..... | ..... | 1,078 | ..... | 3 |
| Hog cholera | ..... | ..... | ..... | ..... | 10,721 | ..... | ..... | ..... | ..... |
| Tumors and abscesses | 156 | 6,938 | 27 | 85 | 1,086 | 1,339 | 131 | 47 | 2 |
| Septicemia, pyemia, and uremia | 1,320 | ..... | 440 | ..... | 6,056 | ..... | 705 | ..... | 5 |
| Pregnancy and recent parturition | 221 | ..... | ..... | ..... | 40 | ..... | 42 | ..... | 1 |
| Immaturity | ..... | ..... | 3,583 | ..... | ..... | ..... | ..... | ..... | ..... |
| Pneumonia, pleurisy, enteritis, hepatitis, peritonitis, metritis, etc. | 2,281 | ..... | 525 | ..... | 4,601 | ..... | 1,838 | ..... | 10 |
| Icterus | 49 | ..... | 31 | ..... | 1,594 | ..... | 939 | ..... | 3 |
| Texas fever | 480 | ..... | 1,120 | ..... | ..... | ..... | ..... | ..... | ..... |
| Injuries, bruises, etc. | 2,222 | 1,825 | 373 | 255 | 412 | 4,357 | 621 | 121 | 2 |
| Sexual odor | ..... | ..... | ..... | ..... | 1,126 | ..... | ..... | ..... | ..... |
| Asphyxiation | ..... | ..... | ..... | ..... | 633 | ..... | 51 | ..... | ..... |
| Emaciation | 4,492 | ..... | 1,203 | ..... | 690 | ..... | 5,088 | ..... | 29 |
| Miscellaneous | 448 | 5,248 | 172 | 130 | 1,001 | 1,471 | 345 | 7,226 | 6 |
| Total | 39,402 | 123,969 | 7,654 | 781 | 59,477 | 877,528 | 10,789 | 7,394 | 61 |

[1] This term is applied to carcasses held on suspicion on first post-mortem examination to be subjected later to more thorough examination for determining final disposition.

In addition to the foregoing there were tanked the carcasses of animals found dead or in a dying condition as follows: Cattle, 685; calves, 844; swine, 20,906; sheep, 3,787; goats, 8; total, 26,230.

SUPERVISION OF PREPARATION OF MEATS AND PRODUCTS.

The amount of meats and meat food products prepared and processed under the supervision of the bureau is shown in the following statement, being an increase of 11.4 per cent over the fiscal year 1910.

*Meat and meat food products prepared and processed under bureau supervision, fiscal year 1911.*

| Kind of products. | Weight. | Kind of products. | Weight. |
|---|---|---|---|
| | *Pounds.* | | *Pounds.* |
| Beef placed in cure | 217,467,983 | Bakers' compound | 2,617,743 |
| Pork placed in cure | 2,568,148,924 | Oleo stock and edible tallow | 70,319,941 |
| All other classes placed in cure | 2,436,967 | Oleo oil | 171,006,496 |
| Sausage chopped | 488,814,318 | Oleo stearin | 87,616,254 |
| Canned beef | 116,100,087 | Oleomargarin or butterine | 117,848,128 |
| Canned pork | 25,270,451 | Mutton stock | 1,211,610 |
| All other canned meats | 3,571,805 | Mutton oil | 2,957,821 |
| Meat extract | 361,870 | Mutton stearin | 2,198,576 |
| Steam and kettle rendered lard | 1,086,628,132 | Oleo and mutton stock | 12,871 |
| Leaf lard | 18,090,259 | Oleo and mutton oil | 1,509,685 |
| Neutral lard | 80,784,960 | Oleo and mutton stearin | 222,274 |
| Lard oil | 6,521,840 | Miscellaneous products | 1,187,088,790 |
| Lard stearin | 5,248,560 | Total | 6,984,233,214 |
| Lard compound | 5,521,196 | | |
| Lard substitute | 664,705,741 | | |

The following quantities of meats and meat food products were condemned on reinspection during the fiscal year because of having become sour, tainted, putrid, unclean, rancid, or otherwise unwholesome: Beef, 12,106,336 pounds; pork, 8,747,016 pounds; mutton, 176,414 pounds; veal, 43,470 pounds; goat meat, 341 pounds; total, 21,073,577 pounds. This is an apparent increase of 10.7 per cent over the previous year, but subtracting from these figures the large amount of product condemned at one establishment on account of an extensive fire (over 3,000,000 pounds), and taking into consideration the great increase in the amount of meat food products prepared during the fiscal year (over 700,000,000 pounds), the proportionate amount of product condemned on reinspection shows a gratifying decrease, which indicates continued improvement in sanitary conditions and in methods of preparing and handling the products.

INTERCHANGE OF MEATS BETWEEN INSPECTED ESTABLISHMENTS.

Considerable quantities of meats and meat food products that have been inspected and passed are transferred between inspected establishments, this traffic being closely supervised and the meats and

products identified by means of marks and seals. During the fiscal year there were transferred in this manner 3,126,643,825 pounds of meats and meat food products, part of which was contained in 17,884 sealed cars and 17,067 sealed wagons.

MEATS AND PRODUCTS CERTIFIED FOR EXPORT.

The quantities of meat and meat food products certified by the bureau for export are shown in the following table, being an increase of 19.7 per cent over the fiscal year 1910:

*Inspection certificates issued for export of meat and meat food products, fiscal year 1911.*

| Kinds. | Number. | Beef. | Mutton. | Pork. | Total. |
|---|---|---|---|---|---|
| | | *Pounds.* | *Pounds.* | *Pounds.* | *Pounds.* |
| Regular | 60,953 | 221,460,262 | 5,696,152 | 542,723,179 | 769,884,593 |
| Preservative | 29,471 | 1,981,081 | ..... | 203,200,332 | 205,181,413 |
| Total | 90,424 | 223,441,343 | 5,696,152 | 745,923,511 | 975,066,006 |

There were also issued 2,836 "inedible product" certificates covering exports of 25,553,053 pounds of such inedible products as hoofs, horns, casings, bladders, bungs, etc.

EXEMPTION FROM INSPECTION.

The provisions of the meat-inspection law requiring inspection do not apply to animals slaughtered by farmers on the farm nor to retail butchers and dealers. The department requires that such butchers and dealers, in order to ship meats and meat food products in interstate commerce, shall first obtain certificates of exemption, but no such requirement is made of farmers. The number of certificates of exemption outstanding at the close of the fiscal year was 2,546, as against 2,428 at the close of the previous fiscal year—an increase of 118 certificates. During the year it was found necessary to call in and cancel for various causes 405 certificates of exemption. In many of these cases, however, the certificates were reissued later when business was resumed or when insanitary conditions had been corrected.

During the past fiscal year retail butchers and dealers, shipping under certificates of exemption, have been requested to give a more detailed description of the meats and meat food products shipped, so that it is now possible to show the shipments of carcasses by species and to give the separate amounts of the different classes of fresh meats shipped. During the year 116,536 shipments were made, covering products as shown in the following table:

*Shipments made under certificates of exemption from inspection during the fiscal year 1911.*

| Kind of products. | Number. | Pounds. | Kind of products. | Number. | Pounds. |
|---|---|---|---|---|---|
| Beef, quarters | 2,629 | 252,945 | Cured meats | | 1,308,268 |
| Calves, carcasses | 77,667 | 6,363,152 | Lard | | 38,977 |
| Sheep, carcasses | 5,324 | 202,623 | Sausage | | 178,657 |
| Swine, carcasses | 1,477 | 146,641 | Miscellaneous (scrapple, tripe, head cheese, beef fat, etc.) | | 253,170 |
| Beef, fresh | | 8,209,576 | | | |
| Veal, fresh | | 593,475 | Total | 87,097 | 19,817,877 |
| Mutton, fresh | | 1,672,424 | | | |
| Pork, fresh | | 547,969 | | | |

INSPECTIONS FOR THE NAVY.

Upon request of the Navy Department occasional inspections of meats and meat food products were made for the Navy during the year. The meats and products inspected aggregated 11,112,060 pounds, of which 405,459 pounds were rejected. Rejections were made on account of the sour, slimy, tainted, or putrid condition of the product, for failure to comply with the specifications regarding weight or the amount of fat, and because of the substitution of buck, bull, heifer, or cow meat for the meat of wethers and steers. There were also inspected for the Navy 68,682 dozen eggs, 17,962 dozen of which were rejected.

## CONTROL OF CONTAGIOUS DISEASES.

### TEXAS FEVER.

The number of cattle shipped from the quarantined area to northern markets during the quarantine season of 1910 was 1,065,119, being a decrease of 329,539 head, or 23.6 per cent, as compared with the previous year. Since the quarantine now extends throughout the year, and it is desired to have this report cover the fiscal instead of the calendar year, the following figures are given for the 18 months from January 1, 1910, to June 30, 1911: Cattle shipped to northern markets, 1,325,060, which were transported in 48,563 cars, 37,180 of which were reported as having been cleaned and disinfected under bureau supervision. Reshipments were made from quarantine pens of 359,833 cattle carried in 13,208 cars.

The number of cattle of the quarantined area inspected during the fiscal year 1911, and permitted unrestricted movement as provided in the regulations, under 983 certificates of inspection issued by bureau inspectors, was 103,338, a decrease of 28 per cent, as compared with 1910. Of this number of cattle moved under certificate, 45,613 were dipped or otherwise treated as provided in the regulations,

which is an increase of 30 per cent over the number so dipped or treated in the previous year.

TICK ERADICATION.

As the result of the work done in cooperation with authorities of various Southern States for the extermination of the ticks which spread the infection of Texas fever of cattle, areas aggregating 10,965 square miles, as shown by the following table, were released from quarantine during the fiscal year:

| States. | Square miles. | States. | Square miles. |
|---|---|---|---|
| Mississippi | 625 | Texas | 1,976 |
| North Carolina | 3,794 | Virginia | 773 |
| Oklahoma | 2,142 | Total | 10,965 |
| Tennessee | 1,655 | | |

In addition to the States named, operations are being carried on in the States of South Carolina, Georgia, Alabama, Louisiana, Arkansas, Missouri, and California.

During the year the total number of inspections made by bureau employees was 4,016,448, of which 3,160,255 were reinspections. This is an increase of 7.2 per cent over the inspections of the previous year.

SCABIES IN SHEEP.

During the fiscal year 1911 the area quarantined for scabies in sheep was reduced by releasing from quarantine that portion of Oregon lying west of the Cascade Mountains, an area of 22,560 square miles.

The number of inspections made by bureau employees during the year was 56,584,129, an increase of 7.26 per cent over the inspections of the fiscal year 1910. The number of dippings supervised by bureau employees during the year was 12,715,631, an increase of 4.62 per cent as compared with the previous year. Bureau employees also supervised the cleaning and disinfection of 2,143 cars. The increase in the number of inspections and dippings of sheep is due to scabies eradication work being taken up in the State of Kentucky, where over half a million sheep were inspected; also to the increased movement of sheep from the western ranges to market centers, and to a local outbreak of scabies in two counties in Wyoming, which necessitated the making of a large number of inspections in order that the extent of the outbreak might be fully ascertained.

SCABIES IN CATTLE.

The area quarantined for scabies in cattle was reduced during the fiscal year by releasing 14,810 square miles, consisting of two

counties in South Dakota, eight counties and a part of one other county in Nebraska, and five counties in Kansas.

The number of inspections made during the year was 18,593,251, a slight increase over the previous year. The number of dippings supervised was 1,234,123, a decrease of 7.68 per cent, and 5,761 cars were cleaned and disinfected.

### SCABIES IN HORSES.

The number of horses and mules inspected for scabies during the fiscal year was 3,550 and the number dipped was 124, a decrease of 69.8 per cent in the number inspected and of 89.8 per cent in the number dipped.

### GLANDERS IN HORSES.

There were inspected for glanders at Indian schools and agencies 52,088 horses and mules, of which 68 were found to be diseased and 252 exposed to the disease. This is an increase of 220 per cent over the number inspected in 1910. This work was done in cooperation with the Office of Indian Affairs of the Department of the Interior.

### LIP-AND-LEG ULCERATION OF SHEEP.

The area under quarantine for lip-and-leg ulceration (necrobacillosis) among sheep was reduced by 34,086 square miles during the fiscal year, leaving only 22,175 square miles still in quarantine on June 30, and this entire area has since been released (Aug. 10, 1911). The number of inspections during the year for this disease was 6,459,790. The number of sheep dipped and hand treated in compliance with the regulations was 1,102,516.

### INSPECTION OF LIVE STOCK FOR INTERSTATE MOVEMENT.

The work of inspecting and testing with tuberculin cattle for interstate movement was assigned to the Inspection Division at the beginning of the fiscal year, and veterinarians at numerous stations were instructed to inspect and test with tuberculin, when such testing was required by the laws of the State or Territory to which the animals were destined, cattle moving interstate for purposes other than immediate slaughter. During the fiscal year such inspection was made of 52,230 animals, of which 18,778 were tested with tuberculin. Of those tested, 467 were found to be diseased with tuberculosis and 81 showed temperatures which required them to be held as suspects for further examination.

During the fiscal year there were also inspected by bureau veterinarians 34,789 horses and mules intended for interstate movement. Of this number 5,789 animals were tested with mallein, 175 showed typical reactions to the test, and 174 were held as suspicious and refused interstate certificates until further investigation could be made.

### VIOLATIONS OF LIVE-STOCK TRANSPORTATION LAWS.

During the fiscal year a large number of reports of alleged violations of laws concerning the interstate transportation of live stock were submitted by bureau employees, and 969 such cases (793 of which were for violation of the so-called 28-hour law and 176 for violation of the act of March 3, 1905, and quarantine regulations based thereon) were referred to the Department Solicitor, who in turn presented to the Department of Justice for prosecution such as seemed to be supported by sufficient evidence. Many of the cases tried in court required special investigations and the collection of evidence by employees of the bureau who cooperated with the United States attorneys in charge of the cases.

## THE QUARANTINE DIVISION.

The Quarantine Division, of which Dr. R. W. Hickman is the chief, supervises work of the bureau in connection with the exportation and importation of live stock, including the inspection and equipment of vessels carrying export animals, the management of quarantine stations at the various ports of entry for imported animals, and the inspection and disinfection of imported hay, hides, wool, etc. It also conducts investigations concerning bovine tuberculosis in cooperation with State and municipal authorities and investigations of animal diseases in Porto Rico and the Hawaiian Islands, and carries on correspondence relating to miscellaneous animal diseases.

### INSPECTION OF VESSELS AND EXPORT ANIMALS.

During the fiscal year 438 inspections of vessels carrying live stock were made before clearance, and 764 certificates of inspection were issued for American cattle, sheep, and horses. The following table gives statistics of inspection of live animals for export during the year:

*Inspections of American and Canadian animals for export, fiscal year 1911.*

| Kind of animals. | American. | | | | Canadian. | | |
|---|---|---|---|---|---|---|---|
| | Inspections. | Rejected. | Tagged. | Exported. | Inspections. | Rejected. | Exported. |
| Cattle | 268,531 | 141 | 138,541 | 135,748 | 32,330 | 5 | 32,325 |
| Sheep | 98,277 | 42 | ---------- | 55,952 | 140 | ---------- | 140 |
| Swine | 23 | ---------- | ---------- | 23 | ---------- | ---------- | ---------- |
| Horses | 1,450 | ---------- | ---------- | 1,579 | ---------- | ---------- | ---------- |
| Mules | 2,064 | ---------- | ---------- | 2,064 | ---------- | ---------- | ---------- |
| Asses | 4 | ---------- | ---------- | 4 | ---------- | ---------- | ---------- |
| Goats | 19 | ---------- | ---------- | 19 | ---------- | ---------- | ---------- |
| Zebra | 1 | ---------- | ---------- | 1 | ---------- | ---------- | ---------- |
| Total | 370,369 | 183 | 138,541 | 195,390 | 32,470 | 5 | 32,465 |

Most of the animals included in the above statement were shipped to Great Britain, namely, of American animals, 134,572 cattle, 37,051 sheep, 678 horses, and 8 mules, and of Canadian animals, 32,225 cattle.

As a result of the inspection of the equipment of vessels carrying export animals, statistics show a reduction in the already low percentage of loss of animals at sea. Of cattle shipped to British ports but 0.09 per cent were lost at sea, and of sheep, but 0.50 per cent were lost.

During the fiscal year 13,404 horses and 1,046 mules were inspected and tested with mallein by bureau veterinarians for shipment to Canada. Of this number 251 horses and 12 mules were rejected on account of having reacted to the test.

For shipment to Canada there were also tested with tuberculin 460 cattle, of which 16 reacted; and inspections were made of 28,428 sheep, 25 goats, and 110 swine.

For shipment to the Hawaiian Islands there were tested with tuberculin 93 cattle, of which 5 reacted, and the mallein test was applied to 555 horses and 466 mules, of which 23 horses and 16 mules reacted.

Reacting animals were excluded from exportation.

### INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

Owing to the existence of communicable diseases of animals among the live stock of various parts of the world, importations from over seas have been mainly restricted to Great Britain, Ireland, and the Channel Islands, and during a portion of the fiscal year importations from Great Britain were not permitted on account of an outbreak of foot-and-mouth disease. It is required that a permit be procured from the Secretary of Agriculture prior to the shipment from countries other than North America of cattle, sheep, and other ruminants and swine for their landing subject to inspection and for their detention in quarantine at one of the Federal quarantine stations at the port of entry. Horses are admitted subject to inspection and without quarantine. Dogs imported from any part of the world except North America are subject to inspection or inspection and quarantine for a period not to exceed two weeks or until it can be determined whether such dogs are the hosts of the tapeworm (*Tænia cœnurus*) which produces gid in sheep. The number of animals imported during the fiscal year is shown in detail by the following tables:

*Number of imported animals inspected and quarantined, fiscal year 1911.*

| Ports of entry. | Cattle. | Sheep. | Swine. | Goats. | Other animals. |
|---|---|---|---|---|---|
| New York | 1,915 | 221 | 43 | ---------- | 136 |
| Boston | 242 | 1,283 | 14 | ---------- | ---------- |
| Baltimore | ---------- | 2 | ---------- | ---------- | 2 |
| Canadian border ports | 147 | 88 | 32 | 2 | ---------- |
| Total | 2,304 | 1,594 | 89 | 2 | 138 |

*Number of imported animals inspected but not quarantined, fiscal year 1911.*

| Ports of entry. | Cattle. | Sheep. | Swine. | Horses and ponies. | Mules and asses. | Burros. | Donkeys. | Zebras. | Goats. | Deer. | Other animals. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| New York | ------- | ------- | ------- | 4,687 | ------ | ------ | 11 | 2 | ------- | ------ | ------ |
| Boston | ------- | ------- | ------- | 81 | 4 | ------ | ------ | ------ | ------- | ------ | ------ |
| Philadelphia | ------- | ------- | ------- | 2 | ------ | ------ | ------ | ------ | ------- | ------ | 13 |
| Baltimore | ------- | ------- | ------- | 65 | 10 | ------ | ------ | ------ | ------- | ------ | ------ |
| Portland, Me | ------- | ------- | ------- | 12 | ------ | ------ | ------ | ------ | ------- | ------ | ------ |
| San Francisco | ------- | ------- | ------- | ------- | 1 | ------ | ------ | ------ | ------- | ------ | ------ |
| New Orleans | ------- | ------- | ------- | 6 | 4 | ------ | ------ | ------ | ------- | ------ | ------ |
| Mexican border ports | 181,509 | 2,063 | 357 | 3,051 | 2,220 | 20 | ------ | ------ | 7,964 | 16 | 5 |
| Canadian border ports | 2,347 | 45,829 | 2,096 | 4,712 | 34 | 1 | 3 | 1 | 8 | ------ | 197 |
| Total | 183,856 | 47,912 | 2,453 | 12,616 | 2,273 | 21 | 14 | 3 | 7,972 | 16 | 215 |

TUBERCULIN TESTS IN GREAT BRITAIN.

The regulations governing the importation of animals subject to inspection and quarantine provide that all cattle 6 months old or over imported from Great Britain, Ireland, and the Channel Islands shall be tested with tuberculin by an inspector of the Bureau of Animal Industry before being exported or after arrival at the animal quarantine station at the port of entry. The following table shows the results of such tests made in Great Britain during the fiscal year:

*Results of tuberculin tests in Great Britain of cattle for importation, fiscal year 1911.*

| Breeds. | Passed. | Failed. | Breeds. | Passed. | Failed. |
|---|---|---|---|---|---|
| Alderney | 158 | 0 | Jersey | 1,035 | 6 |
| Ayrshire | 151 | 36 | Shorthorn | 12 | 3 |
| Black Polled Angus | 2 | 0 | Sussex | 1 | 1 |
| Dexter | 39 | 0 | Total | 2,210 | 58 |
| Guernsey | 812 | 12 | | | |

### NEW QUARANTINE STATION FOR BALTIMORE.

With an appropriation made by Congress the bureau was successful in purchasing for a quarantine station for the port of Baltimore a tract of land at Turners Station on the Baltimore & Sparrows Point Railway, with the tracks crossing the east side of the property, and a good water front on the Patapsco River, about 4 miles from the cattle steamer docks and within the lighterage area. The work of erecting fences and constructing buildings is being pushed as rapidly as possible in order to provide early accommodations for importers who desire to use this port of entry. This station when completed will be the only animal quarantine station located on a water front.

### SUPPRESSION OF BOVINE TUBERCULOSIS.

### TUBERCULIN TESTING OF CATTLE IN VIRGINIA AND MARYLAND.

The tuberculin testing of cattle in Virginia and Maryland, which was started in 1907 in cooperation with the health department of the District of Columbia, and which in 1910 was extended to cooperation with the dairy and food commissioner of the State of Virginia, has been continued throughout the past year with encouraging progress and results. This is evidenced by the increased number of cattle tested, the marked reduction in the percentage of reacting animals in previously tested herds, and the confirmation of reactions to the tuberculin test among slaughtered animals to the extent of 98.27 per cent. The results of these tests are shown in the following tables:

*Results of tuberculin testing of dairy cattle in Virginia and Maryland, fiscal year 1911.*

| Items. | Number of cattle tested. | Number passed. | Number reacted. | Number of suspects. | Percentage of reactors and suspects. |
|---|---|---|---|---|---|
| Virginia: | | | | | |
| Cattle not previously tested | 1,924 | 1,660 | 255 | 9 | 13.72 |
| Annual retests | 2,408 | 2,312 | 77 | 14 | 3.79 |
| Total | 4,327 | 3,972 | 332 | 23 | 8.20 |
| Maryland: | | | | | |
| Cattle not previously tested | 1,134 | 907 | 211 | 16 | 20.02 |
| Annual retests | 713 | 676 | 35 | 2 | 5.17 |
| Total | 1,847 | 1,583 | 246 | 18 | 14.29 |
| Cattle not previously tested, both States | 3,058 | 2,567 | 466 | 25 | 16.06 |
| Annual retests, both States | 3,116 | 2,988 | 112 | 16 | 4.10 |

The total number of cattle in Virginia and Maryland tested during the fiscal year was 6,174, which was an increase of 3,456 over the number tested during the previous year. Of this total, 5,555 passed,

578 reacted, and 41 were regarded as suspicious, making a general percentage of reactors and suspects of 10.02.

Post-mortem examination of the carcasses of reactors that were slaughtered under bureau supervision showed 80.16 per cent to be affected with localized tuberculosis, while 18.11 per cent showed generalized lesions, and lesions were not found in 1.73 per cent.

ERADICATION OF BOVINE TUBERCULOSIS IN THE DISTRICT OF COLUMBIA.

The work of eradicating tuberculosis from the District of Columbia, which was undertaken in the fall of 1909 in cooperation with the Commissioners of the District, was continued throughout the fiscal year 1911 by the systematic retesting, at intervals of approximately six months, of all cattle which had been upon premises found to have been infected at the time of the first test, and the retesting of all other cattle in the District after an interval of one year. These latter retests are not yet completed. The tuberculin test was also applied to all cattle entering the District of Columbia for purposes other than immediate slaughter. A considerable number of persons who were cattle owners at the time the order of the commissioners became effective have since ceased to keep cattle, thus reducing the number of premises, although the total number of cattle within the District of Columbia has undergone but slight variation.

Cattle were found on 80 of the previously infected premises, and the retesting disclosed infection on only 12 of these premises, thus showing a reduction of 85 per cent in the number of infected premises since the original tests. The number of cattle retested on previously infected premises was 798, of which 764 passed and 34 or 4.26 per cent reacted. All of these reactors have been slaughtered, and in every instance post-mortem examination showed lesions of tuberculosis. These lesions were found to be localized in 85.29 per cent of the carcasses and generalized in 14.71 per cent.

Annual retests were applied to 484 cattle upon 278 premises which appeared to be free from infection at the time of the first test. Of these 477 passed, and 7 reactors were found. Seven, or 2.52 per cent, of newly infected premises were thus discovered by these retests, representing 1.45 per cent of tuberculous cattle. The 7 reactors were slaughtered, and in each instance showed localized lesions of tuberculosis of such a character that it was evident that the disease had been contracted since the original testing of these animals.

The combination of the results of the retests of cattle within the District upon previously infected and upon previously free premises shows that 1,282 cattle were retested upon 358 premises. Of these 1,241 passed and 41 reacted, the percentage of reactors being 3.20, with signs of infection showing upon 5.31 per cent of the premises.

Forty of the reactors have been slaughtered, and tuberculosis was demonstrated upon post-mortem examination in each instance, 87.5 per cent of the carcasses showing localized lesions and 12.5 per cent showing generalized lesions.

An important feature for the control of tuberculosis within any definite area is the prevention of the introduction of additional cases of tuberculosis from the outside. The regulations governing the admission and tuberculin testing of cattle entering the District were therefore stringently enforced, and 685 cattle were tagged, quarantined, and submitted to the tuberculin test. The majority of these were brought into the District in lots by cattle dealers, while the remaining portion represented the entries of private cows. In the case of the dealers, for commercial reasons the cattle were tested as soon as practicable after their arrival within the District, the cattle being housed in unaccustomed surroundings. Thirty-two reacted to the test, and of the 28 slaughtered lesions of tuberculosis were found in 27 carcasses, in spite of the unfavorable conditions under which tests were applied. Two of the reacting cows were slaughtered through mistakes of their owners, without an opportunity being given for post-mortem examinations, and the remaining two cows are yet to be slaughtered. The low percentage of tuberculosis in cattle brought into the District, compared with the percentage of tuberculosis found by bureau tests applied in Virginia and Maryland, is attributable to the fact that the dealers have been shown by the results of the test which localities or herds show the greatest freedom from tuberculosis.

The following is a summary of all tuberculin tests applied in connection with bovine tuberculosis in the District of Columbia during the fiscal year:

| | |
|---|---|
| Total number of cattle tested | 1,967 |
| Number passed | 1,894 |
| Number reacting | 73 |
| Percentage of reactors | 3.71 |
| Reactions confirmed by post-mortem examination—per cent | 98.63 |
| Failure to demonstrate tuberculosis (1 cow)—do | 1.37 |

Under the provision requiring the identification and tagging of cows and bulls entering the District for slaughter purposes, 831 tags were attached for 35 shippers.

These investigations will be continued throughout the coming fiscal year.

### BOVINE TUBERCULOSIS UPON INDIAN RESERVATIONS.

The arrangements for cooperation with the Office of Indian Affairs of the Department of the Interior in the investigation of bovine tuberculosis and dairy conditions at the various Indian schools and reser-

vations were conducted as arranged during the previous fiscal year. Tuberculin tests were applied by bureau inspectors to a total of 1,600 cattle upon 86 premises. Of these animals 1,538 passed satisfactory tests, 38 reacted, and the remaining 24 were regarded as suspicious. As a result of these tests, applied in various States, to cattle which were maintained largely under natural conditions in the open upon the reservations, it was found that the percentage of tuberculosis was 3.88.

### LIVE-STOCK DISEASES IN PORTO RICO AND HAWAII.

Efforts for the control of communicable diseases among animals in Porto Rico and Hawaii, and for the education of the natives of these two countries in regard to the importance of such measures, have been continued throughout the past year under the supervision of Dr. Thomas A. Allen, bureau inspector in Porto Rico, and Dr. Victor A. Nörgaard, territorial veterinarian and bureau inspector in Hawaii. The control of glanders and tuberculosis has received special consideration in Hawaii.

## THE PATHOLOGICAL DIVISION.

The Pathological Division, of which Dr. John R. Mohler is chief, is mainly engaged in the scientific investigation of animal diseases.

### COMPLEMENT-FIXATION TEST FOR GLANDERS.

Prominent among the new lines of laboratory investigation conducted by this division may be mentioned the complement-fixation test as applied to the diagnosis of glanders. The results obtained from the use of this method have been very satisfactory and have proved it to be most reliable in the detection of occult or latent cases of glanders.

As a result of the recent publication of Bulletin 136, descriptive of this test, different State and city laboratories have undertaken the work of applying it to the diagnosis of glanders, the bureau furnishing detailed information to all those interested in the work, and also material (glanders bacilli extract or hemolytic amboceptors) necessary for the test.

Samples of blood from horses suspected of being affected with glanders have been received and tested daily at the laboratory. About 1,500 tests have thus been made. The results show the specificity of the test, as normal horses and those affected with diseases other than glanders gave no reaction, while those affected with glanders gave positive fixations.

A modification of the agglutination test has been employed in a large number of cases, in conjunction with the complement-fixation

test, to great advantage. In this modification the agglutination in the test tubes is hastened by centrifugalization, and the results may be read after the tubes have been placed in an incubator for two hours. Thus the two tests can be worked together without much difficulty and greater accuracy of diagnosis can thereby be secured.

### GLANDERS IN LIONS.

Blood from a lion belonging to a circus troupe passing through Kansas and Iowa was forwarded to this laboratory for examination. The veterinarian in charge supplied the following information:

Bleeding from the nose, ulcers in the nostrils, sores on the legs, face, feet, and back. Condition has existed for some six weeks. Twelve other lions similarly affected.

The serum of this blood gave positive results to both complement-fixation and agglutination tests for glanders. Cases of glanders in zoological gardens among the carnivora are not infrequent, and in most instances the disease assumes an enzootic form. The animals of the feline family are more susceptible than those belonging to the canine family. In almost all outbreaks the feeding of meat of horses affected with glanders was the medium by which the disease was disseminated.

### THE RECURRENCE OF DOURINE IN THE UNITED STATES.

On May 27, 1911, the bureau received a letter from Dr. J. I. Gibson, State veterinarian of Iowa, stating that there was in Taylor County an outbreak of a disease of horses, suspected of being dourine, and requesting that an expert be sent to make an investigation. The disease had been reported by Dr. A. H. Quin, a practitioner of Creston, Iowa, and his diagnosis was subsequently confirmed on the part of the bureau by Drs. A. D. Melvin, John R. Mohler, and E. T. Davison, who were of the unanimous opinion that the symptoms and lesions manifested were the most typical of any of the cases they had observed. Three of the affected mares were at once purchased and sent to Washington for experimental purposes. After a careful and prolonged examination of almost 200 microscopic slides, six living, wriggling trypanosomes (*Trypanosoma equiperdum*) were found on June 28, 1911, in the blood-tinged serum obtained from a recently developed plaque on the abdomen of one of the mares, thus confirming the diagnosis and also establishing the identity of the disease with that of Asia, Africa, and continental Europe. These trypanosomes have always been very scanty and are only found after prolonged and tedious examination. This is the first discovery of the *Trypanosoma equiperdum* in the natural cases of dourine in the United States, although in 1903 considerable work was done with this trypanosome

imported from France and subsequently inoculated into horses at the Bethesda Experiment Station. Previous to 1911 there had been no authentic cases of dourine reported among the horses of the United States since 1906, although there had been a number of alleged or suspected cases brought to the bureau's attention from time to time which demanded a full investigation, but always with negative results.

In the outbreak of dourine recently discovered in Taylor County, Iowa, 5 stallions have been found affected and 5 exposed to this disease. One of the former stallions has since died of the infection. In addition, 9 mares have shown symptoms of dourine, 1 of which subsequently died of the disease, 5 are suspicious cases, and 94 have been exposed but at present show no evidence of infection. These diseased animals, together with all exposed stallions and mares, were immediately quarantined by the State. Those showing lesions of the disease were purchased by the Government and destroyed, while the exposed animals are still in quarantine under observation. Several Federal and State inspectors are making farm-to-farm inspections with the view of discovering any latent or hidden cases, and it is now believed that the infection is entirely under control. The source from which this center of infection was derived is only a matter of conjecture, but there is apparently no connection between this and any of the previous outbreaks. No authentic information as to the origin of the outbreak has been discovered up to the present time, but all cases lead back to a Percheron stallion imported from France in 1909, and brought directly to Lenox, Iowa. The possibility of such animals bringing the infection into this country must be apparent from the following explanation:

Schneider and Buffard maintain that in France dourine appears nearly every year in the Department of Basses-Pyrénées on the Spanish frontier. It is stated that mares get infected by the asses or horses by which they are covered. It is the custom to have a mare first covered by an ass, and if not impregnated she is then served by a stallion. The asses operate on both sides of the frontier, and in this way introduce the disease into France from Spain, where it has been known to occur for years, especially in Navarre.

A complete description of this disease, its cause, and methods of eradication, has recently been issued by the bureau as Bulletin 142.

### RINGWORM OF SHEEP.

Recently a large wool house submitted to the bureau some interesting samples of diseased wool for diagnosis. A microscopic examination showed the hair shafts to be affected with spores and filaments of the fungus *Trichophyton tonsurans*, the causative agent of ring worm, involving the entire fiber of the clip to within one-half

inch of the end of the hair. This is the first case of ringworm in sheep which has been reported to the bureau, and, owing to its rarity, sheep owners and herders are requested to take cognizance of the condition of the wool simulating this disease in order that both medical and preventive treatment may be applied before the disease has gained a strong foothold. While this disease occurs quite commonly in horses and cattle, and also in dogs and cats, the infection is infrequent in sheep and hogs.

In sheep the disease affects the wool and the outer layer of the skin and is contagious, being readily transmitted from one animal to another. It is characterized by the formation on the head, neck, chest, or back of round patches varying in size from a 5-cent piece to the palm of the hand, covered by branlike epidermal scales. On the wooly portions of the body there is manifest the flattening of one or more small tufts of wool, which become irregularly matted or felted together, and when separated show a dense scurvy accumulation around the roots. By and by the wool is shed and may hang in tufts among the healthy fibers. The skin appears reddened, and in the center shows frequently a brownish discoloration. The itching is more or less pronounced, which causes the sheep to rub and injure the fleece, although the itching is not nearly so bad as in scabies.

The mode of infection consists in the penetration of the hair follicles by the fungus, where it multiplies and surrounds the base of the shaft with a complete mantle and then enters into its interior and renders it brittle and easily broken. The hairs at first become erect, and then appear dull, lustless, devoid of elasticity, extremely fragile, and dead white in color, resembling strands of hemp or asbestos. Inflammation of the follicles is produced, which finally results in loosening and loss of the wool.

Ringworm can be readily differentiated from scabies by the dry, asbestoslike brittle condition of the wool covering the lesion, as well as by the condition of the skin, which in scabies is markedly thickened and covered by crusts or scabs. Besides, the scab mites are absent, while the microscopic examination will show the presence of the fungus above mentioned.

The treatment should consist in clipping the wool from the affected parts and rubbing the lesions with either a 5 per cent carbolized vaseline or a mixture of soft soap, lard, and carbolic acid in the proportion of 1 part of carbolic acid, 5 parts of lard, and 10 parts of soft soap. This is an excellent preliminary treatment and is used in order to soften the scabs and scales from the outer layer of the skin. After one or two days this is followed by the application of antiparasitic remedies, of which the ordinary blue ointment and tincture of iodin are among the best. Much better results will naturally be obtained after the sheep have been shorn. The infected animals

should be separated from the healthy sheep and not returned to the band until the lesions have all disappeared.

### NECROBACILLOSIS IN DOMESTIC ANIMALS.

While comparatively few cases of lip-and-leg ulceration of sheep came to the attention of this laboratory, a few very interesting cases of necrobacillosis of other domestic animals were received for diagnosis. Several calves at a local Government institution died of an unusual malady. The aid of the bureau was invoked, and upon autopsy marked indications of necrophorus invasion were evident. The mucous membrane of the rumen showed a marked denudation of epithelium and areas of irregular yellowish-gray necrotic patches. The reticulum was slightly inflamed. The omasum presented many elevated caseo-necrotic ulcers and patches on the mucosa. The abomasum and almost the entire intestinal tract were severely inflamed. The heart was studded with petechial hemorrhages. Smears made from the lesions in the rumen and omasum proved upon microscopic examination to be teeming with the characteristic long, beaded filaments of necrophorus bacilli. Lesions in the heart failed to show any microorganisms, thus eliminating bovisepticus as a possible causative agent. The veterinarian in charge of the live stock at that institution reported that the lesions in the other affected calves were similar to those found at the laboratory.

The lungs of a horse suspected by a veterinarian of being infected with glanders were found to be affected with necrotic pneumonia, caused by necrophorus bacilli. Upon further inquiry into the history of this case it was learned that the horse had also suffered from a severe attack of necrotic stomatitis.

Bovine lungs studded with nodules of various sizes, greenish yellow in color, were received for diagnosis. The contents of the nodules varied in consistency from gluey pus to a cheesy necrotic mass. Smears from these nodules revealed the presence of necrophorus bacilli. In all instances the microscopic findings were substantiated by animal inoculations. *Bacillus necrophorus* has likewise been isolated from a case of necrosis of the bovine udder in which the teats were primarily involved.

### CHRONIC BACTERIAL DYSENTERY.

Owing to the increasing recognition of the importance of chronic bacterial dysentery as an infectious disease of widespread occurrence and its questionable relationship to tuberculosis, considerable work has been done in an attempt to grow the causative microorganism in pure culture on artificial media, so that its biological characteristics might be studied and animal-inoculation experiments carried on.

During the past year several specimens of cattle intestines and feces received in the laboratory from the States of Oregon and Virginia and the District of Columbia were found to contain the acid-fast bacillus of this disease. From this material numerous inoculations were made on the ordinary culture media with negative results. A special medium was then prepared from the mucous lining of the intestines of a cow; and while it appeared that the implanted bacilli had multiplied in some of the tubes, the results were not sufficiently definite. Another special medium, consisting of ground tubercle bacilli and agar, was used for a series of inoculations, but likewise failed to produce a growth. In all of these experiments the bacilli to be inoculated on the culture media were secured by dissolving the infected intestinal mucosa in an antiformin solution of sufficient strength to destroy all other organisms present, it being assumed that as the bacilli of chronic bacterial enteritis are not dissolved readily by strong antiformin solutions they retain their vitality, as is the case with tubercle bacilli.

### SWAMP FEVER.

Leaving out of consideration the experiments which have not yet been completed and those which have merely corroborated statements already published, the results of the work of the past year on swamp fever of horses have been largely negative. The observations gathered, however, have suggested new lines of attack, which promise to lead to more definite results. The investigation of this disease has reached a stage where it is absolutely essential that an accurate and early method of diagnosis be discovered, inasmuch as without this it is impossible to determine accurately the value of any line of experimental treatment, the progress of experiments in immunizing, or to establish the identity of the disease in localities where it has not previously been recognized. Experiments having this object in view are now in progress.

Experiments have been undertaken to determine whether the complement-fixation method of diagnosis, which has been found so accurate with glanders, can not be utilized also in swamp fever. For the antigen, shake extracts were prepared from the spleen, liver, and heart muscle of an animal dead of the disease. These different extracts were employed in dilutions established by titrations. The complement-fixation test was then applied with sera of horses affected with swamp fever and also with sera of horses suffering from other diseases, as well as with sera of normal horses. The results obtained showed that a partial fixation of the complement had taken place in all tubes containing serum from horses affected with swamp fever, while in all other tubes complete hemolysis was present. The fixation was most pronounced in the tubes in which the spleen extract

had been used as antigen. Further experiments will determine whether it will be possible to employ this test for the diagnosis of swamp fever, as the limited number of cases examined do not warrant definite conclusions.

The experiments in treatment with various medicinal agents have not been satisfactory, because it has been impossible to determine accurately the results of treatment. Owing to this lack of a diagnostic method, it has been impossible to determine the real value of treatment even in cases where it had been apparently beneficial.

### TUBERCULOSIS INVESTIGATIONS.

An opportunity was offered during the year to gain a valuable amount of material for study from hogs that had been raised at an insane asylum, where they had been fed upon garbage collected at the kitchen of the section in which the tuberculous insane were kept. Six of the animals kept under these conditions were found to be tuberculous at autopsy, and from their lesions cultures were obtained that were satisfactory for study. Of this number two cultures presented the characteristics of the human type of tubercle bacilli. They were not rapidly fatal to rabbits, were more or less long, curved, and beaded in conformation, and were prompt to produce visible growth when planted upon culture media. The bacilli obtained from the remaining four hogs were short and straight, and caused the death of the test rabbits in from 19 to 22 days, thus demonstrating their bovine origin.

The ophthalmic and intradermal tests for the detection of tuberculosis in cattle have received additional attention. These methods thus far have not proved sufficiently superior to the subcutaneous injection of tuberculin to warrant their general application in practice, although they are still being tested whenever suitable opportunities are offered. A special preparation known as "phymatin" has been used in the ophthalmic test and has given better results than the alcoholic-precipitated tuberculin. The ophthalmic and intradermal methods of applying the tuberculin test possess so many advantages, especially in the simplicity of reading the results, that the absolute acceptance of either one would be a great aid in the eradication of tuberculosis. Both methods obviate the laborious operation of taking temperatures repeatedly during the day after the injection, and no preliminary temperatures are required.

Determined efforts are being made in certain sections of the country to eradicate tuberculosis from among the dairy cattle of those regions. In the course of the tuberculin testing necessary for the accomplishment of this desired end there will occasionally be found animals that apparently react to tuberculin but in whose

bodies no lesions of tuberculosis can be found at the time of autopsy. Lymph glands from a number of these cases have been forwarded to the Pathological Division for bacteriological examination, and in many instances it is found that the tuberculin reaction was correct, although the tuberculous lesions were not well advanced. In this class of cases the demonstration of living tubercle bacilli within the tissues affords sufficient justification of the tuberculin reaction.

### RABIES.

The diagnosis of rabies by the examination of brain tissues of suspected animals forwarded to the bureau forms an important part of the routine work of the Pathological Division. During the fiscal year rabies has been diagnosed from various sections within easy reach of Washington, and by studying the histories of the cases it can be readily understood how rabies may exist in an enzootic form where a large number of animals have been bitten and no adequate measures for control instituted. An instance of this is seen in an enzootic occurring in and near Glencoe, Baltimore County, Md., from which place reports have been received of the death of many cows with rabiform symptoms.

The method of diagnosis by the detection of Negri bodies in the hippocampus major has been used almost exclusively. Examination of changes in the plexiform ganglia has not been resorted to in a single instance. The inoculation of rabbits has been necessary in fewer instances than in previous years, and has been employed, then, only in cases where dogs have inflicted wounds on persons or animals and a satisfactory diagnosis could not be made by the detection of Negri bodies. In cases where the suspect inflicted no injury to man or beast only the examination for Negri bodies was conducted.

During the year there were examined the brains of 152 dogs, 9 cats, 1 goat, 8 cattle, 2 hogs, and 1 horse, a total of 173 cases. Of these there were found to have been affected with rabies 117 dogs, 4 cats, 7 cattle, 1 goat, and 1 horse, a total of 130 cases. Of these positive cases 75 came from the District of Columbia, 25 from Virginia, 21 from Maryland, 3 from West Virginia, 2 from New York, 2 from Kentucky, 1 from New Jersey, and 1 from Tennessee.

### SO-CALLED "BLACK TONGUE" OF DOGS.

The bureau has received several reports of the existence of a disease termed "black tongue" among dogs, which appeared to be of an infectious nature and almost invariably fatal. The disease exists principally in the Southern States. Hunting dogs are most frequently affected, and pet animals and common dogs are also susceptible; but it appears that the infection prevails to a greater

extent in the fields, woods, or pastures, which explains the greater frequency of the disease among sporting dogs. The symptoms as described in the reports are not of a uniform character, although it is evident that in most instances the predominating manifestations are the lesions in the mouth. The dark discoloration of the tongue appears to be a constant symptom. Other lesions in the mouth may consist of a swelling and reddening of the mucous membrane with erosions and even ulceration. These lesions are most often found around the frenum of the tongue and on the gums and cheeks. The inflammation of the mucous membrane frequently extends to the stomach and intestines, in which the mucous membrane discloses a severe catarrhal inflammation. The affected animals lose strength rapidly and die within a few days from the onset of the disease. Recoveries may occur in exceptional cases.

One form of so-called black tongue has been studied in the laboratories of the Pathological Division. In this instance it affected several animals of a Mexican breed. The symptoms appeared as described above, and a bacteriological examination of the lesions revealed the presence of *Bacillus necrophorus*. A treatment with antiseptic mouth washes and intestinal disinfection appeared to give beneficial results, and thorough and repeated disinfection of the premises prevented the infection among the remaining healthy dogs.

The term " black tongue " as a name for any disease is unfounded, as this simply represents a symptom which may be present in various diseases, such as dumb rabies, distemper, Stuttgart disease (typhus canum), necrobacillosis, certain forms of pneumonia, etc. It simply implies a dark discoloration of the mucous membrane of the tongue, which may result from various causes. Thus, for instance, in dumb rabies the dryness of the tongue and the accumulation of dirt on its surface give it the peculiar dark appearance; in other diseases a cyanotic condition may be responsible for the discoloration.

Requests have been made through different sources for material for the further study of the disease existing among the dogs of the South, and it is hoped that it will be possible to discover the nature and successful treatment of the disease.

### AUTOPSIES ON WILD ANIMALS.

The National Zoological Park continues to furnish quite an important percentage of the necropsies made by the Pathological Division. During the past fiscal year 114 animals, including mammals, birds, and reptiles, were received from this source. The results of post-mortem examination, as in previous years, show the frequent occurrence of digestive and respiratory disorders, diseased conditions involving these systems outnumbering all other affections combined.

While lack of sufficient exercise and unaccustomed climatic conditions are important predisposing factors, the active agents in numerous instances were specifically determined. Mycosis of the lungs as a consequence of aspergillus invasion was particularly destructive to birds, as were also intestinal disorders of protozoan origin. The presence of parasites was not infrequently associated with gastric and intestinal lesions. Of the bacterial diseases, tuberculosis continued to be a menacing factor at the park. Autopsies indicate that monkeys are especially susceptible to this disease.

### SKIN DISEASES IN SWINE.

The work at the branch pathological laboratory located at Chicago, Ill., has steadily increased. During the past year a large number of specimens have been forwarded by inspectors located at this and tributary stations for diagnosis.

Two interesting conditions of the skin of swine have been studied. One is that of nævi pigmentosi. These nævi, or pigmented moles, are congenital and are seen most frequently in black swine, although red and spotted animals are not exempted. They appear as inky black irregularly round spots, from one-eighth to one-half inch in diameter. In some cases they may be much larger; in such cases they are elevated and are covered with stiff coarse hair which grows straight outward. The usual location is in the skin over the back and hams, although they may affect the skin on any part of the body. Usually only a few spots are present, but occasionally an animal is found where they are quite numerous. Inspectors on the killing floors of slaughterhouses report that from 16 to 19 per cent of the hogs are affected. If the small black spots are incised, it will be found that there is a black semifluid pigment deposited between the layers of the skin, while in the larger spots the pigment may extend into the fat beneath.

The other condition is that of elephantiasis papillomatosa. In this condition there is a marked hypertrophy of the papillary layer of the skin involving all or part of the surface of the body. The skin of animals so affected is much thickened and very rough, and gives lodgment to sebaceous material and dirt. When the elephantiasis extends all over the body there are deep wrinkles over the head and neck, also on the sides. Animals so affected are called "mangy hogs" by those engaged in buying hogs. So far the etiology has not been determined, but the affection is evidently not of a contagious nature.

### BLACKLEG INVESTIGATIONS.

During the fiscal year the Pathological Division has prepared for free distribution over 1,000,000 doses of blackleg vaccine. With the

increased interest that is being manifested in the live-stock industry, as is evidenced by the gradual replacement of the more resistant common range cattle by higher grade stock, the necessity for immunization against this virulent disease appears to be more thoroughly appreciated.

The results of vaccinations for the fiscal year ending June 30, 1910, as reported to the bureau by stock owners who have used the vaccine, are equally as satisfactory as in former years. An examination of the statistics serves to emphasize the degree of immunity that is established by vaccination of the susceptible cattle.

### AUTOGENIC VACCINES.

Quite a number of cases of abscess, poll evil, and fistulous withers have been successfully treated with autogenic vaccines made directly from pus germs isolated from the affected animals. The mode of procedure was as follows: Sterile, wide-mouthed bottles were furnished practitioners with instructions to sterilize the exterior surfaces and collect the pus from the last pus that could be expressed from the abscess, or in the case of a closed abscess, to aspirate the pus by means of a sterile hypodermic syringe. This material was then examined microscopically for the presence of staphylococci or streptococci. In some instances the material aspirated from closed abscess proved sterile, and in others there were so few of the germs that it became necessary to incubate the material overnight to cause their multiplication so that good, luxuriant growth could be obtained. Four or five slanted agar tubes were then inseminated thoroughly and incubated two days, in case the predominating forms were streptococci, or one day in case staphylococci were in greater abundance. The growths were then washed down with normal salt solutions and devitalized by heating in a water bath at 55° C. for one hour. The resulting emulsion or suspension of killed bacteria constitutes the vaccine, and is injected subcutaneously, under aseptic precautions, into the root of the neck at its lowest part where the skin is thin and where the resulting reaction can be readily seen. At the same time the ordinary surgical measures, such as dependent openings and drainage, are carried out, as the vaccination treatment should be considered adjunctive only.

It is necessary to know the approximate number of bacteria in the dose of the vaccine, and this is determined by making the vaccine as turbid as a standard tube containing 50,000,000 bacteria per cubic centimeter. An instrument known as a turbidometer has been devised for determining these turbidities.

Two methods of administration were followed, one in which the dose was very small and repeated every four days until six or seven doses had been given, the other in which the dose was very much

larger. In the first method of dosage there is little or no reaction from the injections, and the beneficial effects are sometimes delayed. In the second method the reaction is pronounced, consisting of swelling at the site of operation and increase of the discharge from the abscess, it being necessary to wait for several days for the reaction to subside before giving the next dose. On account of this there is little gained in point of time, and moreover the owner is sometimes averse to allowing the treatment to proceed when he sees his animal apparently "made worse," even if only temporarily so.

The first dose given by the slow method—that is, where very small doses are used—is 0.4 cubic centimeter, or 20,000,000 bacteria. The dose is increased by 0.2 cubic centimeter at each dose, so that at the seventh dose the number of bacteria injected is 80,000,000.

The large doses cause a decided temporary drop in resistance of the animal, or a negative phase, which is manifested by depression, increased discharge, and swelling at the point of inoculation. This is succeeded in a few days by increased resistance or increased positive phase. When the smaller doses are given, the short, mild, negative phase is soon succeeded by the positive phase, and thus immunity is built up without the usual depression, etc., to which the owner objects so much. Efforts are now being made to reduce the number of vaccinations to the minimum.

The so-called stock cultures of pus-forming organisms have also been used instead of those freshly isolated from the pus material in order to compare the curative effects, and in nearly every instance the stock cultures fail to give as good results as the more virulent organisms isolated from each case.

### INVESTIGATIONS OF POULTRY DISEASES.

Lesions closely resembling those of tuberculosis were discovered about the heads, necks, and wings of some pigeons which had been forwarded to the bureau because of the growth of certain lumps or tumorlike masses in their subcutaneous tissues. These growths developed until they had finally reached the size of chestnuts and were firmly encapsulated. A little pressure after an incision had been made caused the spherical contents of the sac to roll out as a solid ball. A transverse section of this growth showed that it was made up of successive layers of yellowish material. An examination of this material under the microscope revealed the presence in large numbers of acid-fast bacilli which closely simulated avian tubercle bacilli. A closer examination of these rods, however, showed that they were not typical of the acid-fast bacilli usually found in tubercular material from fowls. Pappenheim's test demonstrated that this bacillus was acid-fast only, not acid-alcohol fast. The growths were therefore probably not tubercular.

This "lumpy" disease of pigeons can be developed in other pigeons in about 10 days, whereas genuine tuberculosis of pigeons requires three weeks and more for its development in experimental cases. It therefore appears that this quite common disease of pigeons, usually pronounced tuberculosis on acount of having acid-fast bacilli in the cheesy material, must be studied further in order to determine the relationship between this affection and that of avian tuberculosis. A similar disease has been observed about the heads of several Minorca fowls.

### THE GERMICIDAL AND KEEPING PROPERTIES OF RAW AND PASTEURIZED MILK.

The germicidal property of raw milk and pasteurized milk was compared by inoculating each kind with a given volume of various kinds of bacteria which could be readily recognized upon agar plates by their pigment or peculiar characteristics of growth. Bacterial counts were made of the raw and pasteurized milk before inoculating with any organism. The sample of milk was in the majority of cases divided into six lots, three being pasteurized at a given temperature. After the three samples of pasteurized milk cooled to 40° C. six were inoculated with a given organism. One of the raw and one of the pasteurized samples were placed in an incubator at 37° C., one of each at room temperature (25° C.), and one of each in a refrigerator (15° C.). Bacterial counts were made of all the samples at various intervals to determine which favored most the growth of the inoculated organism. The organisms used for inoculation were *Bacillus prodigiosus*, *B. pyocyaneus*, *B. staphylococcus*, *B. aureus*, and anthrax vaccine.

Comparisons were also made of heated and unheated milk serum and of raw milk serum with horse serum. The keeping qualities of raw milk and of milk pasteurized at various temperatures were compared.

The pasteurization in all instances was done by immersing the samples in water with a thermometer placed in the milk for recording the temperature.

No definite conclusions could be drawn regarding the bactericidal property of raw milk, as the results varied. The raw-milk serum showed no superior bactericidal property over the pasteurized serum. Pasteurization aided in the keeping qualities of milk, depending upon the length of time and the degree of temperature.

### THE BIOCHEMIC DIVISION.

The work of the Biochemic Division, of which Dr. M. Dorset is chief, has consisted of laboratory work incident to the meat inspec-

tion, laboratory research work relating to meat products, investigations concerning hog cholera, the examination and preparation of stock dips, and the preparation and distribution of tuberculin and mallein.

### LABORATORY MEAT INSPECTION.

The laboratory meat inspection is carried out by a central laboratory and six branch laboratories located in as many different cities. At the beginning of the fiscal year a comprehensive plan for the collection and examination of samples, based upon the preceding year's experience, was adopted and has been followed throughout the year. The result has been to enable the laboratories to do considerably more work, thus rendering the inspection more complete and thorough without increasing the cost.

During the fiscal year the laboratories examined 25,818 samples of all kinds. These examinations included inspection for the presence of prohibited preservatives, prohibited coloring matter, adulterants, and unwholesomeness in meat and meat food products of various kinds, and the examination of salt, spices, condiments, cereals, and other articles used in the preparation of meat food products. They include also the sanitary examination of a large number of different water supplies.

These samples were drawn chiefly from houses at which meat inspection is maintained, and they show that in inspected houses the use of prohibited preservatives and coloring matters is not practiced. In a very small fraction of 1 per cent of all the samples examined prohibited preservatives were found, but this was evidently due to ignorance or carelessness and not to intentional violation of the regulations on the part of inspected establishments. As in the preceding fiscal year, it was found that the most frequent violation of the regulations consisted in the use of cereal substances in sausages and similar products without proper declaration on the labels, and as a result of giving special attention to this matter considerable improvement was noted toward the end of the fiscal year. Not infrequently lards otherwise apparently pure have been found to give a positive Halphen reaction for cottonseed oil, but in almost every case the amount indicated was extremely small, and it appears from investigations made in the laboratories and hereinafter described that this condition results from the feeding of cottonseed products to hogs before slaughter.

During the year 231 sanitary analyses of water supplies were made. These examinations included a study of the surroundings of each water supply and also a chemical and bacteriological analysis. As a result of these examinations the bureau has ordered the discontinuance of 19 different water supplies which were found to be un-

suitable for use on meat food products, and in all cases water supplies of undoubted wholesomeness have been substituted.

Twelve samples involving five alleged violations of the meat-inspection law were examined in the laboratory. The laboratory examinations sustained the findings of the inspector in all cases. The facts were reported to the department solicitor for appropriate action.

During the year 3,560 gallons of branding ink prepared in the Biochemic Division were shipped to inspectors in charge of meat inspection. The total cost of this ink, including materials, labor, and containers for shipment, was $1,310.

### RESEARCH WORK.

The character of the research work carried out in connection with the laboratory inspection of meats has naturally been governed in great part by the questions which have arisen as a result of the routine work. A great number of different problems have received attention. The more important work of this kind is briefly described as follows:

In collaboration with the referee on food adulteration of the Association of Official Agricultural Chemists a number of analyses of samples of lards and other fats were made with the object of determining the most satisfactory means of detecting adulterations of these products. This work has been completed, and the results are in the hands of the referee.

Under the meat-inspection regulations packers are permitted to use seven coal-tar dyes for coloring the outer casings of sausage, provided the color is applied in such a way as not to penetrate the casing. The laboratories have received many samples of proprietary coloring mixtures supposed to consist of two or more of the seven permitted colors. As no method for separating coal-tar colors in mixtures had ever been devised, it was necessary for some procedure of this kind to be worked out in order to determine whether or not mixtures proposed for use on sausage casings were actually composed of the seven permitted colors and no others. Research work by Dr. T. M. Price, in charge of the Washington laboratory, resulted in the development of a method which appears to be entirely satisfactory, and will, it is believed, be of great value not only to the laboratories of this bureau but also to all others engaged in food-control work. The method is described in Circular 180 of the Bureau of Animal Industry.

The laboratories are frequently called upon by veterinary inspectors to determine the presence of bile pigments in fats from animals which are suspected of being affected with jaundice. The laboratory inspector at East St. Louis, Mr. C. T. Marsh, devised a method by

which the bile pigment may be separated from the fats and a positive diagnosis in doubtful cases of jaundice may be made. This work has not yet been published.

Laboratory inspection of lards from certain packing houses showed regularly a positive Halphen test for cottonseed oil, the amount indicated by the test being quite small and therefore impossible of detection by the phytosterol acetate test, even though cottonseed oil had been added to the lard. An investigation of this subject has shown that this cottonseed-oil reaction was due not to adulteration, but to the feeding of hogs on garbage which contained cottonseed products, chiefly cottonseed oil. It is known that large quantities of cottonseed oil are used in salads and for baking and cooking generally, and it is not surprising that the fat of hogs fed on garbage shows a Halphen reaction, as it has been previously known that the feeding of cottonseed meal will produce this result. The work leading to this discovery was carried out by Mr. R. H. Kerr, of the Washington laboratory, and Mr. A. E. Graham, of the San Francisco laboratory.

A bacteriological study of hog carcasses was made with the object of determining whether or not hog cholera bacilli or related organisms belonging to the *Bacillus enteritidis* group were present in the carcasses of hogs which at autopsy showed lesions of hog cholera. The work was carried out at Chicago and Washington, and included a bacteriological study of four classes of hog carcasses, namely, normal carcasses which showed no cholera lesions, carcasses with slight lesions of cholera which had been passed for food, carcasses with more extensive lesions of cholera which had been passed for lard, and carcasses showing extensive lesions of cholera and which had been condemned for offal. The carcasses in the second, third, and fourth groups corresponded to those specified in paragraphs 1, 2, and 3 of section 10, regulation 13, of the meat-inspection regulations (Bureau of Animal Industry Order 150), and were obtained from packing houses in the course of routine inspection. Cultures were taken from practically all parts of the carcass, including the liver, spleen, kidneys, lymphatic glands, heart muscle, and voluntary muscle.

The results of this investigation showed that organisms of the colon-typhoid group were almost constantly present in the livers of normal hogs, but seldom in the other tissues. In the case of hogs affected with hog cholera, colon-typhoid organisms were not only present in the liver, but were quite generally distributed through the other tissues as well. There appeared to be little, if any, difference in the occurrence and distribution of colon-typhoid organisms in the three classes of cholera hogs studied—that is, colon-typhoid organisms were present as frequently in the organs and tissues of carcasses showing slight cholera lesions as in the carcasses showing extensive cholera lesions. No organisms of the *Bacillus enteritidis* or so-called

hog-cholera group were found. The organisms referred to as belonging to the colon-typhoid group presented the usual characters of the colon bacillus, some strains fermenting glucose, lactose, and saccharose, and some only glucose and lactose. There were also organisms which corresponded with the classical description of *Bacillus fecalis alkaligenes*. No organisms corresponding to the typhoid bacillus were found.

Some packing houses have experienced difficulty in preparing the product known as "sausage in oil" so that it would keep well after being taken out of the refrigerator. An investigation was undertaken with the object of improving, if possible, the methods of manufacture. The study showed that sausage in oil as found in the market in unopened cans is never sterile, organisms of the subtilis group being constantly present and occasionally also organisms of the colon-typhoid and proteus groups. Eighteen packing establishments were visited by Dr. McBryde, of this division, and the methods of processing and handling this product were observed. In no case was the inside temperature of the cans raised sufficiently high in processing to insure the sterility of the product. Experiments were carried out at different plants to determine how high the cans could be heated without injury to the product, and also to determine the effect of this heating on the bacteria which exist in the sausage when it is packed. These experiments showed that temperatures above 195° F. usually injure the casings of this sausage to such an extent that its market value is seriously impaired. Under these conditions it is manifestly impossible to destroy the very resistant spores of *Bacillus subtilis* in the sausage after it has been packed, as a much higher temperature than 195° F. would be required. This temperature, however, would be sufficient to destroy the nonspore-bearing organisms of the colon-typhoid and proteus groups.

As a result of practical tests and laboratory study, recommendations were made that all cans of sausage in oil be heated sufficiently high to insure an inside temperature of 160° F., and that this temperature be maintained for at least one-half hour. It seems not unlikely that the spores of *Bacillus subtilis* are chiefly introduced through the cereals added to the sausage, and experiments are being carried out to determine whether these organisms may be destroyed by heating the cereals before they are added to the sausage.

Recent investigations at establishments under inspection have revealed the presence of foreign material in the livers of swine. Such livers are characterized by slightly raised, light-brownish areas which give to the organs a somewhat mottled appearance. These areas do not resemble a parasitic condition, but are quite characteristic and may be readily recognized. When cut across the affected area the livers show a lighter color than the normal liver tissue, and this con-

dition is more noticeable around the hepatic veins. These livers frequently contain hair, and in some instances bristles are found protruding from the smaller branches of the hepatic veins. Frequently these hairs are attached to rounded plugs of fat or to masses of chocolate-brown material. The plugs of fat are particles of tissue from the sticker's wound in the neck which are driven into the vessels by the beaters in the dehairing machine. The chocolate-brown material represents discolored blood clots which result from the action of the hot wash water on the blood of the veins. In some establishments a large percentage of the hog livers show the condition above described.

The presence of this foreign material is noted where a certain type of dehairing machine is used and the hogs pass through it head up. The hair and dirty wash water enter the sticker's wound and gain entrance to the liver through the heart and posterior vena cava. The objectionable condition can be overcome by requiring that the hogs pass through this type of machine head down and that the practice of pumping back dirty wash water and applying it to carcasses be discontinued. This finding has resulted in an order directing that all livers contaminated in the manner indicated above be condemned.

The study of the effect of prolonged storage on canned meats has been continued. During the past year a careful chemical, histological, and bacteriological study has been made of the different classes of canned meats in storage, and the remainder of the samples are being held for later examination. A part will be examined during the coming fiscal year and others will be stored for a still longer time. The results so far are not of sufficient importance nor are they sufficiently well substantiated to warrant a detailed report.

In addition to the lines of work reported above, a considerable amount of time has been given to the consideration of the questions of less importance, such as the solubility of paraffin and sulphur in lard, the production of formaldehyde by heating concentrated cane-sugar solution, the suitability of silicate and shellac as protective coverings for galvanized containers, and a study of the constituents of meat extracts and of extracts made from organs with a view to identifying these either alone or in mixture. A refrigerating machine was installed and a few cold-storage rooms were constructed preliminary to study of the effect of cold storage on meats.

### DIPS AND DISINFECTANTS.

It was stated in last year's report that a formula had been evolved for a concentrated arsenical dip for tick-eradication work and that the preparation was undergoing practical tests in the field. The results of these tests were satisfactory, and as a consequence the preparation of this dip for limited use by bureau employees in the

field has become a part of the routine work of the laboratory. Thus far a sufficient amount of this dip has been sent out to make over 30,000 gallons of diluted dipping bath.

The arsenical dip employed for cattle has been the subject of some study throughout the year along such lines as a search for formulas which will afford a concentrated dip, the best method for obtaining a good tar emulsion, the applicability of hard waters for preparing the dip, and certain precautions necessary for obtaining complete solution of arsenic. The work has enabled the laboratory to make some suggestions of value in the preparation of such dips.

As a result of the analysis of certain samples of arsenical baths in which cattle had been dipped, it was discovered that under certain conditions arsenious solutions prepared by boiling arsenious oxid with sodium carbonate are subject to oxidation, so that after several weeks nearly all the arsenic is to be found in the form of salts of arsenic acid. The cause of the change appears attributable to bacterial activity. An account of the work done in studying the change and in tracing its cause has been prepared for publication.

For a number of reasons it appears desirable that the bureau should have knowledge of the degree of absorption or retention of arsenic by the various tissues of cattle dipped in arsenical solutions, such as are at present in use for combating the Texas fever cattle tick. Experiments intended to obtain the desired information are already under way, the work being carried out in collaboration with the Zoological Division.

During the year there was developed a method for the determination of nicotin in nicotin solutions and tobacco extracts, which seems to offer decided advantages over methods previously available. An account of this work and a description of the method have been published as Bureau of Animal Industry Bulletin 133.

For more than two years dimethyl sulphate has been employed in this laboratory as a reagent for testing creosote oils and dips prepared therefrom. The test has proved of such value that a description of it has been published as Bureau of Animal Industry Circular 167.

An investigation into the effect upon the composition of coal-tar creosote baths caused by the passage of sheep through such baths has been continued from the previous year. It was proved that as dipping is continued the percentage of cresylic acid contained in such baths becomes progressively less. It is probable, therefore, that as sheep pass through such baths their wool to a certain extent plays the part of a strainer and mechanically removes from the emulsion an undue proportion of globules of oil and cresylic acid.

Examination of samples of dips, disinfectants, and related materials submitted by manufacturers, bureau inspectors, the general supply committee for the executive departments, and by other Gov-

ernment offices, has been continued as in the past with no new developments worthy of note.

Through General Order 143 the Secretary of Agriculture created the Insecticide and Fungicide Board to assist him in the enforcement of the insecticide act of 1910. The Chief of the Biochemic Division was made chairman of the board, and the Secretary directed that a certain part of the work which naturally fell within the province of the Bureau of Animal Industry should be carried out by this bureau. The laboratory work, which has necessitated the assignment of two bureau employees to this work exclusively, has so far consisted in the examination of certain classes of samples.

## TUBERCULIN AND MALLEIN.

The amount of tuberculin furnished to State, county, and municipal officials in various States and Territories for diagnosing tuberculosis in cattle continues to increase. During the past year there was distributed a total of 422,043 doses, this being an increase of approximately 20 per cent over the previous fiscal year.

As all officials who receive tuberculin from this bureau are required to report the results of the tests made by them, a large number of records have been collected during the years that tuberculin has been distributed. During the past year it has been possible to go over a portion of these records, and some interesting data have been secured. It is evident that in determining the reliability of tuberculin it is possible to utilize only such records as show the results of autopsy on the tested animals. Excluding all tests which were defective in any respect, we have been able to secure temperature charts of 8,980 tuberculin tests on cattle that were afterwards slaughtered. In going over these charts the tuberculin reaction has been regarded as positive when the maximum temperature after injection was at least 103.8° F., provided this maximum represented a rise of at least 2° F. above the maximum temperature recorded before injection. In applying this rule to the 8,980 slaughtered cattle it has been found that 550 failed to react, while 8,430 gave a positive reaction. Of the animals which gave a positive reaction, 8,358, or 99.15 per cent, showed lesions of tuberculosis at autopsy. This is considered a remarkably high percentage of accuracy, in view of the fact that this tuberculin was used in general practice in all parts of the country and by a large number of different veterinarians. From these figures, even if unsupported by other evidence, it would appear to be evident that a positive tuberculin reaction is a practically unfailing indication of tuberculosis in the animals tested.

Up to the present time there has been no satisfactory means of standardizing tuberculin. Such a process is highly desirable, for it has been shown that at times there have been placed on the market

tuberculins which were lacking in potency. A study of this subject is now under way in the Biochemic Division.

During the fiscal year 91,642 doses of mallein for the diagnosis of glanders in horses were sent out to public offices. This represents an increase of approximately 25 per cent as compared with the preceding year.

## HOG CHOLERA.

In my last report it was stated that considerable time had been devoted to demonstration work in connection with the production of serum for the prevention of hog cholera, the objects of this work being to demonstrate successfully the value of the serum and thereby to encourage State officials to take up the manufacture of serum for the benefit of farmers, as it was not practicable for the Bureau of Animal Industry to undertake a general distribution to individuals. It now appears that this work has been productive of much good, as 21 States, including practically all of those in which hog raising is an important industry, have made provision for serum production, and not less than 200,000 inoculations have already been made by State officials. The results reported have been extremely favorable, and while the number of hogs treated is not large when compared with the total number in the United States, sufficient has been done to show that the State officials and the farmers are interested, and it is believed that with further development of the work a great deal of good will be accomplished.

A demonstration experiment carried out at the Kansas City stockyards was described in my last report. During the past year a similar experiment was carried out at South Omaha, Nebr. This experiment was undertaken at the request of State officials and the Nebraska Swine Breeders' Association. The Union Stock Yards Co. of South Omaha also offered to cooperate and to bear the expense incident to the purchase and care of the hogs used in the experiment. Thirty pigs weighing from 40 to 60 pounds were purchased from a farm which had been free from hog cholera for several years. These hogs were carried to the stockyards, and on July 23, 1910, four of them were injected with blood from hogs sick of hog cholera. These injected pigs, which were placed in a pen by themselves, became sick on the 28th of July, at which time 18 of the remaining pigs were given one dose of the serum, while the other 8 pigs were not treated in any way. The 18 serum-treated pigs and the 8 untreated pigs were then placed in the same pen with the 4 pigs which had been made sick of hog cholera. The 4 pigs which were inoculated with hog cholera all died. The 8 untreated check pigs all contracted hog cholera from the 4 inoculated ones. The 18 pigs which were given serum and which were confined in the same pen with the 4

original sick pigs and with the 8 untreated pigs which became sick remained perfectly well and were finally turned over to the officials of the stockyards company upon the completion of the experiment on September 17, 1910. The experiment was witnessed by representatives of the Nebraska Agricultural Experiment Station at Lincoln and of the Nebraska Swine Breeders' Association, as well as by representatives of several different agricultural papers published in Nebraska.

The use of carbolized or phenolized blood, as described in my last annual report, has been continued during the year. The later results confirm the earlier observations in showing that the virus of hog cholera may remain in contact with comparatively strong solutions of phenol for weeks without noticeable impairment of its virulence. There seems to be little doubt that phenolized blood will gradually come into general use in connection with the "simultaneous method," as the presence of the phenol prevents the development of putrefactive bacteria and does not destroy the virus of hog cholera. This will enable practitioners to keep virus on hand for a reasonable length of time.

Considerable study has been given to the effect of different preservative agents on the virus of hog cholera as contained in the blood of sick hogs. In addition to the continued study of phenol much attention has been devoted to thymol and formaldehyde. The results with regard to these, however, are not yet complete. Aside from the desirability of having some means of preserving the virus for use in simultaneous inoculations, it is also desirable to have some means of preserving disease-producing blood which is to be used later for hyperimmunization. Phenol is not satisfactory for this purpose, but it is hoped that some efficient germicide which is efficient against ordinary bacteria, but which does not materially affect the virus of hog cholera, will be found suitable for this purpose. Some attention has also been given to different preservatives for serum. These observations are not yet complete.

The study of the immunity possessed by young pigs has been continued, but up to the present time the data obtained are not sufficiently conclusive to warrant a definite statement of results.

### WORK FOR THE COMING YEAR.

During the ensuing fiscal year it is proposed to make a study of the changes taking place in meat during cold storage, the object being to decide upon the best conditions of storage and to ascertain whether or not meat becomes unwholesome after storing for a long time.

A study of the egg breaking and packing industries has also been undertaken and is in charge of a committee consisting of the chiefs

of the Pathological, Animal Husbandry, and Biochemic Divisions. Plans have been made for carrying on this investigation in cooperation with a similar organization in the Bureau of Chemistry.

Other lines of investigation mentioned in this report will be continued, special attention being given to an investigation of the cereal and water in sausage and to methods for the standardization of tuberculin.

## THE ZOOLOGICAL DIVISION.

The Zoological Division, under Dr. B. H. Ransom, chief, has been engaged, as heretofore, in the investigation of parasitic diseases of animals and in the study, collection, and determination of animal parasites.

### ROUNDWORMS OF SHEEP.

The investigations relative to stomach worms and other roundworms parasitic in sheep have been continued. Experiments not yet completed are in progress which are intended to give data on the reduction and prevention of parasitic infection by rotation of pastures.

It has been found that the embryos of the hair lungworms of sheep pass out of the body of infested animals with the feces, and it is probable that infection is spread as commonly through this means as through the sputum.

Important facts have been determined bearing upon the life history of the gullet worm of sheep and cattle.

### TAPEWORMS OF SHEEP.

Investigations have been begun relative to the fringed tapeworm, which in the western United States apparently does more damage than any other internal parasite of sheep, the stomach worm and the nodular worm being as yet rare and of little importance in the Rocky Mountain and Plains regions.

### GID IN SHEEP.

It has been definitely determined by experiment that the tapeworm stage of the gid parasite will develop in coyotes. The coyote is therefore a factor in the spread of this disease as well as the dog. Except for a center of infection in the State of New York, the disease still appears to be enzootic in this country only in Montana. Two publications relative to gid have been issued during the year, one (Bulletin 125) rather technical in character, the other (Circular 165) of a more popular nature.

Gid apparently was introduced into New York through infested sheep dogs imported from Europe, and it was on account of the danger of further occurrences of this kind that B. A. I. Order 176

of November 25, 1910, was issued, providing for the quarantine and inspection of imported sheep dogs.

To determine the presence or absence of tapeworm infection, fecal examinations were made of 52 imported dogs quarantined under the provisions of Order 176. Eighteen of these dogs were found to be infected with tapeworms and received appropriate treatment before they were released from quarantine. The total number of fecal specimens examined, including those taken subsequent to treatment to determine the success of the treatment, was 80. In several instances repeated treatments were necessary before the tapeworm eggs disappeared from the feces. The quarantine and treatment were conducted under the supervision of the Quarantine Division.

### SHEEP SCAB.

The favorable results obtained in the experiments with tobacco dip without sulphur, in cooperation with the Kentucky Agricultural Experiment Station, have been confirmed by the reports of practical dippings in the field by bureau inspectors. Dipping solutions containing 0.07 per cent of nicotin were used. Reports have been received relative to the dipping of 20 lots of sheep infected with scab, comprising 35,515 head, and 1 lot of exposed sheep, comprising 2,950 head. Four of the lots were reported as not exposed to reinfection after dipping, 11 were returned to infected range or pasture, and it was not known in the case of 6 lots whether they were exposed or not. The disease was reported cured in all cases, with no reappearance as determined by inspections made after a lapse of time varying from one to six months in different instances.

As a result of these investigations the use of tobacco dips without sulphur has been permitted in the official dipping of sheep for scabies.

### CATTLE MANGE.

Under the supervision of Dr. W. E. Howe, of this bureau, further experiments in the treatment of cattle mange with a kerosene and soap preparation have been carried out.

On April 14 two lots of mangy cattle (11 and 15, respectively) were treated in a spraying machine with the preparation diluted to give a strength of 8 per cent of kerosene. Five weeks after spraying mites were found in 2 cattle of the first lot and 6 cattle of the second lot.

On April 15 two lots of mangy cattle (11 and 13) were treated in a spraying machine with the preparation diluted to give a strength of 7 per cent of kerosene. Five weeks after treatment mites were found on 2 animals in each lot.

On April 18 two lots of mangy cattle (of 15 each) were dipped in the preparation diluted to give a strength of 7 per cent. Five weeks after treatment mites were found on 1 animal in each lot.

Two lots of mangy cattle (14 and 15) were dipped April 19 and 20, respectively, in the preparation diluted to give a strength of 6 per cent. Five weeks after treatment one lot was apparently free from mange; in the other lot 2 animals were found to be infected.

From these experiments it may be concluded that the kerosene preparation in question is not efficacious in the treatment of cattle mange when used as a dip in a strength of 7 per cent or less or as a spray in a strength of 8 per cent or less, a single application of the remedy being given in either case, even though it is used in the spring of the year, at which time mangy cattle tend to improve in condition without treatment.

### INVESTIGATIONS RELATIVE TO TICK ERADICATION.

Bulletin 130, recording the results of two years' investigations relative to the life history of the cattle tick and other points bearing on tick eradication, which were conducted in cooperation with the veterinary department of the Alabama Polytechnic Institute, was issued during the year.

In experiments with arsenical dips it was found that no appreciable ill effects were produced on calves dipped during the period from the latter part of June to the latter part of October, repeated at intervals of two and three weeks in a dip composed of 10 pounds of arsenic trioxid, 25 pounds of sodium carbonate, 1 gallon of pine tar, and 500 gallons of water.

Two series of experiments were conducted with a proprietary arsenical dip, one during the summer in southern Texas, the other during the fall in Oklahoma. The dip proved efficacious in destroying ticks when applied twice with an interval of 10 days between dippings and at a dilution which gave an equivalent of 0.22 per cent arsenic trioxid in the dipping bath.

Experiments on a small scale with an arsenical dip prepared in concentrated form by the Biochemic Division were sufficiently favorable to warrant field trials of the preparation.

In all of the experimental work with dips the Biochemic Division has cooperated in devising improvements in the preparation of the dips and in supplying analyses of the dips used.

Investigations have been begun in cooperation with the Biochemic Division relative to the absorption of arsenic through the skin of cattle dipped in arsenical dips and the effect of such absorption upon cattle and upon subsequent tick infestation.

### INVESTIGATIONS CONCERNING PARASITIC PROTOZOA.

Further work has been done upon a trypanosome common in the blood of American cattle, but apparently nonpathogenic, and a bulletin recording this work has been prepared for publication.

Interesting and important facts have been determined relative to certain morphological details in the Sarcosporidia.

Fortunately for the live-stock industry of the United States, no exotic trypanosome disease has succeeded in becoming established in this country, although animals as stock and for menageries have been brought here in the past more or less indiscriminately from all parts of the world. Past good fortune, however, does not necessarily promise immunity for the future. As illustrations, it may be noted that importation of animals from Europe went on for several hundred years before that highly injurious pest of live stock, the horn fly, became established (since 1886) in this country, and that dourine was brought in only a few years ago, the first outbreak causing considerable damage before the disease was eradicated. It is therefore highly important that all possible practicable precautions should be taken to guard against the ever imminent danger of introducing trypanosome diseases with shipments of animals from abroad, especially in view of the fact that these diseases, as a rule (dourine being an exception), are transmitted by winged insects, and hence are almost impossible to eradicate if they become established. In order to supply information relative to trypanosomes, in a readily available form, a paper is in preparation, and nearing completion, in which are given the diagnostic characters, life history, host animals, and geographic distribution of all known species of trypanosomes.

### INDEX-CATALOGUE OF MEDICAL AND VETERINARY ZOOLOGY.

The author index of this catalogue has been completed, parts 27 to 34 having been issued during the year, and part 35 having since appeared. Part 36, containing additions and corrections, has been prepared and sent to the printer. In reporting the completion of this index it may be noted that this is one of the most important and valuable reference works on the subject of parasitology ever published and has been greatly in demand not only in this country but also abroad.

### PARASITES OF HOGS.

Some work has been done on the kidney worm, stomach worms, and ascarids of hogs. More extensive investigations of these important parasites are contemplated for the ensuing year.

### MISCELLANEOUS.

Numerous autopsies were performed on various animals, wild and domesticated, and examinations made for the presence of parasites; a large number of specimens sent in by the field force of the bureau and by other correspondents were examined and identified; the usual

amount of correspondence relative to parasitic diseases was received and replied to, and other routine matters have received attention.

An important work on the nematodes parasitic in the alimentary tract of cattle, sheep, and other ruminants, which has been in preparation for several years, has been published as Bulletin 127.

Several new species of parasites discovered in the course of investigations carried on in this division have been described and the descriptions turned over to the United States National Museum for publication.

## THE EXPERIMENT STATION.

The work at the bureau's Experiment Station at Bethesda, Md., under Dr. E. C. Schroeder, superintendent, during the past fiscal year has been of the same general character as in former years, consisting of independent investigations, investigations in cooperation with other divisions of the bureau, and the provision of facilities for the other divisions to make investigations of a kind that require farm and field conditions not obtainable within the limits of the city. During the year most of the work in animal husbandry was transferred to the newly purchased farm at Beltsville, Md., and it is proposed henceforth to confine the work at Bethesda mainly to investigations of animal diseases.

### TUBERCULOSIS INVESTIGATIONS.

Tuberculosis was the subject of the more important investigations of the year. Studies relative to the protective treatment of cattle against this disease have been continued, and while nothing radically new has been discovered the results obtained with various methods of bovo-vaccination against tuberculosis are encouraging. No treatment that will give cattle a practically valuable immunity against tuberculosis without the inoculation of living tubercle bacilli has yielded promising results, and there seems to be no reason for changing the formerly expressed view that the time has not yet come to justify the wholesale injection of cattle with living tubercle bacilli for purely economic purposes, even if the bacilli used are only weakly pathogenic in character.

Some studies have been made on small experiment animals relative to the latency of tubercle bacilli in the tissues of living animals. That tubercle bacilli may enter and remain latent in the bodies of animals for considerable periods of time, and afterwards, for some reasons not well understood, become active and cause tuberculosis, is a belief held by many competent investigators. If this belief should prove true it will have a very important bearing on all measures for the eradication of the disease. The bureau's investigations have not progressed far enough to warrant any conclusions.

diamond skin disease, bighead of sheep, Texas fever and cattle ticks, intestinal parasites of sheep, gid, dips for removing external parasites, inbreeding, studies in Mendelian laws of inheritance, selective breeding, the possible effects of inbreeding on susceptibility of disease, etc.

FUTURE WORK.

Besides continuing unfinished work, the following lines of research are contemplated during the coming year and following years: To repeat tests made a few years ago regarding the frequency with which tubercle bacilli occur in butter; to learn if possible whether American oleomargarin (like European, according to European investigators) contains tubercle bacilli in a fairly large percentage of instances; to make additional tests to determine the frequency with which dairy cows eliminate from their bodies the newly discovered bacillus already mentioned; to make additional tests relative to the frequency with which this bacillus occurs in commercial milk; to make additional tests relative to the significance of this bacillus, especially when it occurs in symbiosis with certain other bacilli, and to determine if possible whether the bacillus is associated with some definable condition in the bodies of the cows that eliminate it. It is also desirable to make further tests relative to the persistence of tubercle bacilli in a virulent state in manure heaps from stables containing tuberculous cattle. Some work on the subject was done during the past year, but we were not able to carry it out in a way to obtain satisfactory material for reliable conclusions.

# THE GOVERNMENT'S INSPECTION AND QUARANTINE SERVICE RELATING TO THE IMPORTATION AND EXPORTATION OF LIVE STOCK.

By RICHARD W. HICKMAN, V. M. D.,
*Chief of the Quarantine Division.*

## INTRODUCTION.

For the protection of the live stock of this country against the introduction of contagious diseases from abroad the Bureau of Animal Industry maintains a system of inspection and quarantine of imported animals. As a further measure of protection, the importation of hides, skins, and certain other animal products, as well as hay, straw, and forage, is also supervised and regulated.[1] This service operates incidentally to keep out certain diseases which are communicable from animals to people, as, for example, Malta fever. In order to promote the country's export trade in live stock and to have this trade carried on under humane conditions, the bureau also inspects animals for export and enforces certain requirements regarding the transportation of such animals on ocean steamers. All this work is under the direct supervision of the Quarantine Division of the bureau.

## THE INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

Although for many years previous to the creation of the Bureau of Animal Industry there had been a growing realization of the need of a Government bureau to foster and protect the live-stock interests, the immediate occasion for the organization of the bureau was the prevalence of contagious pleuropneumonia of cattle. Through lack of protective measures, the contagion of this disease had been repeatedly brought into the United States by cattle imported from Europe, and the disease had spread throughout several eastern States and as far west as Illinois. Great injury was being done by its ravages, and the presence of this and other contagious diseases had led to the exclusion of our animals and meats from foreign markets. The contagion was spreading, and the live-stock industry of the country was seriously threatened.

[1] Some of this work is done in cooperation with the Division of Customs of the Treasury Department. The regulations relating to hides, skins, hide cuttings and parings, and glue stock are issued by that department.

This condition brought about the passage of the act of Congress of May 29, 1884, for the establishment of the Bureau of Animal Industry. The most pressing duty confronting the new bureau was the eradication of contagious pleuropneumonia, and this was finally accomplished after a struggle of several years. No case has occurred in the United States since the spring of 1892.

Concurrently with the inauguration of the campaign against pleuropneumonia, more stringent regulations were promulgated and measures were put into operation with a view to preventing the further importation of diseases from abroad by placing the importation of live stock and their products under more complete governmental sanitary control. Since the passage of the organic act of 1884 additional laws have been enacted from time to time, to which references are made later on in this article. Regulations have been issued and a service of inspection and quarantine maintained.

The regulations regarding the importation of live stock require, in brief, that all horses, cattle, sheep, and other ruminants and swine must be inspected before they are admitted, and, in addition, that all ruminants and swine from any part of the world except North America shall be quarantined. The following table shows the number of animals inspected and the number quarantined during the past five years. Nearly all of the animals admitted on inspection without quarantine come from Canada and Mexico and consist mainly of cattle and sheep for feeding or slaughter, and horses, mules, etc., for work purposes, though some animals from Canada are intended for dairy and breeding purposes. Nearly all of the live stock brought from across the seas are purebred animals for breeding purposes.

*Number of imported animals inspected and quarantined during 5 years ending June 30, 1911.*

| Fiscal year. | Inspected but not quarantined. | Inspected and quarantined. | Total. |
|---|---|---|---|
| 1907 | 146,449 | 1,448 | 147,897 |
| 1908 | 249,396 | 1,494 | 250,890 |
| 1909 | 233,044 | 4,760 | 237,804 |
| 1910 | 336,857 | 9,783 | 346,640 |
| 1911 | 257,351 | 4,127 | 261,478 |
| Total | 1,223,097 | 21,612 | 1,244,709 |

## PROVISIONS OF LAWS AND REGULATIONS.

The work relating to the inspection and quarantine of imported live stock is based mainly upon acts of Congress of August 30, 1890 (26 Stat. L., 416), and February 2, 1903 (32 Stat. L., 791). The

former act was slightly amended by section 12 of the tariff act of August 5, 1909, which provides that the importation of neat cattle and of the hides of neat cattle from any foreign country is prohibited, except as to any foreign country or countries or parts thereof concerning which the Secretary of the Treasury shall officially determine and give public notice that importations therefrom will not tend to the introduction or spread of contagious or infectious diseases among animals in the United States. This was a reenactment of that portion of the old law of August 30, 1890, section 9 of which permitted the importation of cattle only on proclamation of the President, the more recent act transferring the authority to the Secretary of the Treasury, which authority is exercised upon the recommendation of the Secretary of Agriculture. Section 10 of the act of 1890 provides that the Secretary of Agriculture shall cause careful inspection to be made of all imported neat cattle, sheep, and other ruminants and swine; and section 6 makes it a misdemeanor to import neat cattle, sheep, and other ruminants and swine which are diseased or infected with any disease or which have been exposed to such infection within 60 days next preceding their exportation. Section 7 authorizes the Secretary of Agriculture to quarantine such imported animals at such ports as he may designate and under such conditions as he may by regulation prescribe, and section 8 prohibits the importation of such animals at any other ports. Section 2 of the act of 1903 authorizes the Secretary of Agriculture "to make such regulations and take such measures as he may deem proper to prevent the introduction or dissemination of the contagion of any contagious, infectious, or communicable disease of animals from a foreign country into the United States."

The regulations now in force are known as Bureau of Animal Industry Order 180, "Regulations for the inspection and quarantine of horses, cattle, sheep, swine, and other animals imported into the United States," issued by the Secretary of Agriculture under date of April 5, 1911. This order designates certain ports of entry on the seaboard and along the international boundary lines through which live stock for importation must be entered. The ports of entry on the Atlantic seaboard are New York, N. Y., Boston, Mass., and Baltimore, Md. These are the most important, as nearly all the live stock brought into the United States from across the seas are purebred animals imported for breeding purposes. Such animals are eligible for entry free of duty under the provisions of paragraph 492 of the tariff act of 1909. It is required that the pure breeding of every animal which is entered free of duty be established; that it shall be purebred of a recognized breed, and duly registered in the book of record established for that breed. The determination and certification of breeding is done by the Animal Husbandry Divi-

sion of the Bureau of Animal Industry. To accommodate business in imported purebred animals for breeding purposes, animal quarantine stations are maintained convenient to the ports named, the station for New York being located at Athenia, N. J., that for Boston at Littleton, Mass., and that for Baltimore at Turner, Md., on the Patapsco River, an arm of Chesapeake Bay, south of Baltimore. These stations are described later on in this paper.

Copies of the regulations may be obtained on application to the Chief of the Bureau of Animal Industry, Washington, D. C.

### KINDS OF ANIMALS.

The regulations define the term "animals" as applying to those kinds which are subject to inspection only or to inspection and quarantine, as the case may be, referring particularly to horses, asses, mules, cattle, sheep, other ruminants, swine, and collie, shepherd, or sheep dogs; but the regulations also provide that any domestic or other kind of animals which may be offered for importation may be included under the inspection and quarantine requirements when so ordered by the Chief of the Bureau of Animal Industry.

### PERMITS AND OTHER SAFEGUARDS.

An important feature of these regulations in preventing the importation of the infection of animal diseases from foreign countries consists in the requirements relative to the obtaining of two permits. The permits required by the regulations for cattle, sheep, and other ruminants and swine must be procured from the Secretary of Agriculture by prospective importers before shipment. These are issued in triplicate, two copies being sent to the owner or his agent, one of these being addressed to the United States consul at the foreign port of shipment and the other to the collector of customs at the United States port of entry. The former is for presentation to the consul at the port of shipment, in order to entitle the animals to clearance; the latter is to accompany the stock for presentation to the collector of the port along with the other papers to cover their entry. The third copy is forwarded by the bureau, directly at the time of issuing, to the superintendent or veterinary inspector in charge of the quarantine station.

Any ruminants or swine arriving at a port of the United States, for which permits as above have not been procured by the owner or his agent, are denied entry, and such animals are not permitted to land, but remain on the ship and depart upon her leaving the United States.

Other safeguards of the regulations governing the importation of horses, cattle, sheep, and other ruminants and swine are found in the

requirements for certificates and affidavits from the owner and from the proper authority at the place of origin, showing that such animals have been continuously located in the district for six months preceding; that no contagious disease (tuberculosis and actinomycosis excepted) has existed in the district for one year; and that the animals have not passed through any infected region or been exposed on the way to any infectious or contagious disease affecting that kind of animals.

All ruminants and swine are subject to careful veterinary inspection, and those from countries outside of North America are also subject to quarantine. Cattle are required in addition to pass a satisfactory tuberculin test by a bureau inspector stationed in Great Britain, prior to shipment, or in quarantine after arrival. Horses are admitted on inspection without quarantine. All dogs are subject to inspection at the port of entry. Collie, shepherd, or sheep dogs are subject to quarantine.

No litter, fodder, or other aliment, nor any ropes, straps, chains, girths, blankets, poles, buckets, or other things used for or about the animals, and no manure, can be landed from any vessel except under such regulations as may in each case be prescribed. Provision is likewise made for the proper disinfection of vessels and cars which carry animals and of the space which was occupied by them at the quarantine station following their release.

As the granting of permits depends upon sanitary conditions abroad and upon conditions and facilities for caring for animals at the quarantine stations, and as these conditions vary from time to time, intending importers should apply to the bureau for latest information.

### QUARANTINE PERIOD.

The quarantine period required for cattle from Great Britain, Ireland, and the Channel Islands is 30 days, counting from the date of arrival at the quarantine station; and for sheep and other ruminants and swine it is 15 days. After the expiration of the prescribed quarantine period, if the animals are found free from disease they are released.

The requirements regarding the quarantine of cattle, sheep, other ruminants, and swine from countries of North America, especially Canada and Mexico, vary according to circumstances. When quarantine is required the period is one week or longer. For details the reader is referred to the regulations.

The regulations provide for the inspection of dogs. Collie, shepherd, or sheep dogs are also subject to quarantine not to exceed two weeks or until it can be determined by proper examination whether

or not they are the host of the *Tænia cœnurus*, the tapeworm of the dog, which, through the feces of infected dogs, when dropped upon pastures and being devoured by sheep develop into the gid parasite, *Cœnurus cerebralis* (*Multiceps multiceps*), causing the gid disease in sheep.

Horses, asses, mules, sheep, goats, and swine from Asia and Africa are prohibited importation into the United States by Bureau of Animal Industry Order 174, on account of the presence of trypanosomes in those parts of the world. Cattle are not included in this order, as their importation is already prohibited by section 12 of the tariff act, reference to which has already been made.

Certain menagerie animals also come within the scope of the regulations and are inspected and quarantined as conditions require.

### DISEASES IN FOREIGN COUNTRIES AND THEIR EFFECT ON IMPORTS.

Quite a number of foreign countries, particularly those of Europe, maintain sanitary supervision of their live stock and issue periodical reports showing the status of contagious diseases of domestic animals. The reports for the past year show an unprecedented prevalence of disease, especially foot-and-mouth disease, on the Continent of Europe, and this condition has kept the bureau constantly on the alert to prevent the introduction of contagion.

For a period of more than two years prior to November, 1906, the department had permitted the importation of cattle from Belgium and the Netherlands, but about that time foot-and-mouth disease was introduced into Belgium in some French sheep, with the result that before the end of the following month the disease had extended to every Province in Belgium and over the border into the Netherlands. Although the latter country was able to hold the disease in check for a while, control was apparently lost a few months later, and the disease has continued to prevail there, the reports for 1911 showing the most serious condition of any of the preceding five years.

In view of the great prevalence of foot-and-mouth disease in Germany and other countries of continental Europe, and the commercial and contiguous territorial relations existing between the countries of Europe, together with the laxity of methods in combating this disease in some of the continental countries, the conditions have become a very serious economic problem. Even Great Britain, with her stringent sanitary police measures, has suffered repeated outbreaks of the disease during the past year without being able, in a single instance, to determine the source of the contagion. As a consequence of these conditions the United States was obliged to discontinue the issuance of permits for the importation of rumi-

FIG. 1.—YOUNG BULL FOR IMPORTATION, IN STALL ON INCOMING OCEAN STEAMER.

FIG. 2.—TRANSFERRING IMPORTED CATTLE FROM STEAMER DOCK TO LIGHTER AT NEW YORK.

The animals are taken from the dock to cars on the lighter, on which they are transferred to Jersey City, and then shipped by rail to the quarantine station at Athenia.

FIG. 1.—INSPECTING HORSES FOR IMPORTATION ON OCEAN STEAMER.

The inspectors go aboard the steamer on its arrival and examine the horses before they are unloaded.

FIG. 2.—TRANSFERRING IMPORTED HORSES FROM STEAMER DOCK TO LIGHTER AT NEW YORK.

Horses after passing inspection are admitted without quarantine.

THE QUARANTINE STATION FOR IMPORTED ANIMALS AT ATHENIA, N. J.

FIG. 1.—UNLOADING IMPORTED CATTLE AT THE QUARANTINE STATION AT ATHENIA, N. J.

FIG. 2.—STABLES AT THE ATHENIA QUARANTINE STATION.

nants and swine from Great Britain as well as from Belgium and the Netherlands.

The first visitation of foot-and-mouth disease in Great Britain in 1911 occurred about March 9. Our own ports, which had been promptly closed against live stock from Great Britain on receipt by this Government of a report of this outbreak, followed by the canceling of all outstanding permits, were again opened on June 15. On July 5, however, another outbreak was reported, and further outbreaks followed from time to time throughout the remainder of the year, despite the vigorous work of the British Board of Agriculture in promptly slaughtering diseased and exposed cattle, sheep, and swine, and thoroughly disinfecting the infected premises. The disease has since continued to appear in various parts of the country.

During the period from July 5 a large number of importers had been waiting to import cattle, several of them having already purchased animals; and while the department was in full sympathy with them and their interests, it was deemed inadvisable to permit any importations from Great Britain because of the successive outbreaks, and especially the absolute inability of the British Board of Agriculture to determine the sources or means by which the disease was being brought into England or to formulate any plan that was likely to enable them to exclude it. Under such conditions it was impossible to tell where or when it would next appear. The resumption of imports will depend upon the success of the efforts at stamping out the disease in the affected countries. So far the Channel Islands have been successfully protected against the contagion.

### SOME EXAMPLES OF THE SUPPRESSION AND EXCLUSION OF CONTAGIOUS DISEASES FROM ABROAD.

The methods in practice in our international quarantine and sanitary service since the establishment of the Bureau of Animal Industry in 1884 have thus far presented an effectual barrier to the entrance of various contagious diseases from other parts of the world.

Since the eradication of contagious pleuropneumonia, foot-and-mouth disease has probably given this country more concern than any other of the contagious diseases of the Old World which it has been the office and duty of the bureau to guard against. Although this disease has occurred in the United States on five different occasions, namely, in 1870, 1880, 1884, 1902, and 1908, it was promptly eradicated in each instance, and in the case of each of the outbreaks occurring since the organization of the bureau it has been shown that the contagion was not introduced into this country through the importation of live stock or through any of the other channels of entrance over which the bureau has had supervision. The origin

of the outbreaks of 1902 and 1908 was definitely traced to imported vaccine virus used on calves in the propagation of virus for use in vaccinating against smallpox.[1]

When the United States came into possession of the Philippine Islands the Bureau of Animal Industry took up the study of some of the tropical diseases of live stock because of the new danger with which we then seemed to be menaced by returning soldiers, officers, and others desiring to bring animals to the United States from that archipelago. An order was issued by the Secretary of Agriculture, effective December 13, 1901, prohibiting the landing of animals from the Philippine Islands at any of the ports of the United States or its dependencies, as it was soon recognized that almost all of the serious communicable diseases of live stock were to be found there in more or less abundance. And owing to the fact of the United States having a climate, somewhere in its vast area, that would seem adapted to the propagation of almost any kind of an animal disease should it once gain a foothold in this country, it was deemed necessary to control or cut off every possible recognized avenue through which the infection of animal diseases from the Philippines might be introduced, particularly surra and rinderpest.

In addition to the successful exclusion of contagious diseases from the United States, two concrete examples will be given to illustrate the efficient work of the international quarantine service in preventing the escape of infection from quarantine and damage to our live-stock industry, even when through their subtle nature certain contagious diseases have reached our shores.

Surra was found in an importation of zebu cattle shipped from Bombay, India, April 27, 1906, but it was not allowed to escape from the quarantine. This occurrence not only served the purpose of an additional test of the efficiency of our international quarantine service, but at the same time gave the bureau actual experience with this disease, which from time to time has wrought such havoc among stock, especially horses, in oriental countries.

It appears that over 30 years ago Mr. A. H. Pierce introduced into southern Texas a number of the so-called Brahman cattle from India which were successfully crossed on the native cattle, with the result that their progeny were relatively free from ticks, while the native stock in the same pasture would be literally covered with these pests. As a consequence the Brahman grades thrived under the same conditions which served to deplete the native stock. They not only withstood the semitropical weather conditions of the Gulf coast section, but their thin, tough skin, very short hair, and the seeming repugnance of their sebaceous secretion to insect life, rendered them im-

[1] Particulars are given in Bureau of Animal Industry Circular 147.

mune to heavy tick infestation, while at the same time they were immune to Texas fever, their natural habitat being a tick-fever country.

Mr. A. P. Borden, executor of the Pierce estate, was very desirous of making a fresh importation under any necessary precautions prescribed by the department. As he agreed to comply with all of the requirements and to defray the expenses, it was finally arranged to send a veterinary inspector of the bureau, Dr. William Thompson, who had served two years in the veterinary service in the Philippine Islands, to inspect the animals before purchase, inquire into their history, supervise their transfer to the seaboard, and accompany them to the United States, under which conditions a permit was finally granted for their importation.

Dr. Thompson and Mr. Borden met at Bombay, India, on March 31, 1906, and they proceeded together in the selection and purchase of the cattle. Purchases were made in sections reported to be free from rinderpest, surra, contagious pleuropneumonia, foot-and-mouth disease, and all other contagious diseases of cattle, until there were secured in all 46 bulls, 2 cows, 1 heifer, and 2 calves, representing 7 different breeds. The animals were shipped to the agricultural farm at Poona, where microscopic examinations of their blood were made on two different occasions, and as a precautionary measure they were inoculated with antirinderpest serum to guard against any possible exposure during loading or detention at Bombay. They were then transported in cleaned and disinfected cars to Bombay for shipment by steamer. Blood tests were to have been made by rabbit inoculations, but unfortunately it was impossible to obtain the rabbits for this purpose at Bombay. The cattle were shipped from Bombay April 27 for Hamburg, where they were transhipped June 2, and arrived at New York June 16. They were then transferred to a special place of quarantine on Simonsons Island, about 16 miles down the bay, an isolated spot adjoining Staten Island.

In addition to the blood examination at Poona, two subsequent microscopical examinations of the blood of the animals were made during the ocean voyage, but the presence of the surra trypanosome was not detected, and the cattle all arrived in New York Harbor in apparently sound health. Notwithstanding this, however, it was deemed advisable upon their arrival at quarantine to make blood inoculations, which was done under the direction of Dr. John R. Mohler, chief of the Pathological Division of this bureau.[1] It was found as a result of inoculations of the blood from the 49 adult cattle that 3 were infected. The seriousness of the situation, upon finding surra infection in the herd, will be apparent, as the zebus were tied

[1] Further particulars are given in a paper by Drs. Mohler and Thompson in the Twenty-sixth Annual Report of the Bureau of Animal Industry for 1909, p. 81.

on two sides of an open corral, 100 feet square, with no protection from the various kinds of biting flies which were present in great numbers, including the big black horsefly, or breeze fly, *Tabanus atratus*, which Dr. Mohler believes to be responsible for spreading the infection to other animals.

On discovery of surra in the herd an attempt was made to protect the animals from flies by putting up an L-shaped frame with a cotton netting covering, completely closing in the two sides of the corral. It was subsequently deemed necessary, however, in order to ascertain absolutely and to limit the extent of the infection, to put up a frame building with box stalls, so that each animal could be screened off separately. Therefore Mr. Borden erected such a building, with the result that, after the last seven series of tests were successively negatives and a killing frost had occurred, the remaining 33 animals were released from their five-months' quarantine on November 14 and shipped to their destination in Texas, 18 out of the original herd having been destroyed because of surra infection.

Brief reference will also be made to an importation by this bureau in 1905 of 65 head (4 males and 61 females) of milch goats from the island of Malta, a full history of which is published in the Twenty-fifth Annual Report of the bureau. The investigations conducted by Dr. Mohler in connection with these goats led to the discovery, in the milk and urine of a number of them, of the *Micrococcus melitensis*, the causative agent of Malta fever, and to the conclusion that this organism lives a more or less passive existence in the body of the goat, exercising its pathogenic effects when it gains entrance to the human body. It was finally found necessary to destroy all of this importation, including the kids, a number of which proved to be infected.

Thus these and other infectious and contagious diseases of the Old World are excluded and combated through the work of the respective and correlated agencies of the Bureau of Animal Industry.

There are some diseases which, because of their common existence, cause more annoyance in quarantine than others. Among these are necrobacillosis, foot rot in sheep, and infectious diarrhea of young calves. These diseases do not become manifest until the animals are on shipboard or after arrival at the quarantine station. In the handling of other animals, such as may be classed as menagerie ruminants and swine, special precautionary measures such as blood tests and rabbit inoculations are used to prevent the introduction of the infection of surra (*Trypanosoma evansi*) and other trypanosomes.

### SUPERVISION OF THE IMPORTATION OF HIDES.

The proper and satisfactory handling of the work in connection with the importation of hides constitutes one of the most difficult

problems with which our sanitary service has to deal, as there is great danger of introducing infection in this way unless proper precautions are observed. The importation of hides is subject to the same law that governs the importation of cattle, and the regulations are issued by the Secretary of the Treasury on the recommendation of the Secretary of Agriculture. The regulations now in effect (Treasury Department Circular 23, Division of Customs, May 2, 1910) provide for the disinfection of hides by three different methods, as follows:[1]

1. By immersion in a 1 to 1,000 solution of bichlorid of mercury.
2. By immersion in a 5 per cent solution of carbolic acid.
3. By exposure (suspended separately in a tight room) to sulphur dioxid.

Exceptions are made in the disinfection requirements in the case of—

1. Hides the product of, and imported from, any part of North America.
2. Hard, sun-dried hides, also old and worn-out articles of manufacture made from raw hides, such as loom pickers and mallet heads, imported as glue stock.
3. Hides and hide cuttings and parings or glue stock which have been lime dried after soaking for 40 days in a strong lime wash made by slaking quicklime in water and containing sufficient lime to be of a creamy consistency.
4. Abattoir hides, the product of Sweden, Norway, New Zealand, Australia, or Great Britain, when accompanied by a certificate of an official veterinarian showing that the same were taken from cattle free from disease at the time of their slaughter.
5. Hides taken from American cattle killed in lairages in Great Britain.

In the case of all hides offered for shipment from districts of any country in which anthrax is prevalent, disinfection exclusively by immersion for at least 30 minutes in a 1 to 1,000 solution of bichlorid of mercury is required, and certificates of disinfection, by the American consular officer of the district from which the hides are shipped, are required; otherwise the hides are treated as prohibited importations and denied entry. The disinfection of hides on the dock upon arrival of the importing vessel in this country, or their entry for transportation to another country across American territory, is not permitted, for the reason that the landing of diseased hides would tend to the dissemination of cattle diseases. It will be observed that when vessels arrive from foreign countries with hides

[1] The regulations have since been amended so as to allow, in lieu of the immersion of the hides in the disinfecting solution, the wrapping of the bundles or bales of hides in suitably strong and lightly woven bagging which has immediately prior to such use been thoroughly soaked in one of the disinfecting solutions mentioned.

on board which do not belong to the excepted classes, and are unaccompanied by proper consular certification, there is no alternative but for the inspector to see that such hides remain on the vessel and depart with it at the time of next sailing, which, of course, is not agreeable to either the consignor or the consignee.

As the hide output of the big slaughterers and packers in the United States is now to a great extent tanned in their own establishments, the owners of exclusively tanning establishments state that they are absolutely dependent upon foreign importations to keep their tanneries in operation, and that in consequence of the common prevalence of anthrax in some portions of the hide-exporting countries, and the strict enforcement of our sanitary regulations, they are utterly unable at times to procure the necessary stock. A very considerable amount of attention and investigation has been directed to the matter of discovering a practicable method of anthrax sterilization as affecting hides, skins, hair, and wool, without yet having reached a satisfactory solution of this intricate problem. It is claimed by the tanners that the requirements of our sanitary regulations are equivalent to prohibition, since by the immersion of either green-salted or sun-dried hides for 30 minutes in a 1 to 1,000 solution of bichlorid of mercury they are seriously injured for the manufacture of leather. Experiments of the bureau indicate that such is the case, particularly as applying to the hard-dried hides, which the British reports show to be the source of anthrax infection among the handlers and workers much more frequently than green or pickled hides and skins.

Arrangements have been made during the past year, through the State Department and its Consular Service, for the prompt transmission of information by the Bureau of Animal Industry to the tanning and leather associations of the United States regarding the prevalence of anthrax in a consular district abroad, in order that the trade may in turn notify foreign buyers and stop purchases. But to meet satisfactorily the requirements of the situation something more than this is needed. In all tropical and semitropical countries, such as India, China, Africa, and South America, skins are dried either in the sun or in a shaded air current, or are plastered over with an earth salt while drying. The restoration of all such hides to the green, raw, or wet state has always been a source of difficulty and loss to the tanner.

The Bureau of Animal Industry has been making investigations of means for the sterilization of anthrax spores or germs in hides, skins, hair, wool, and other suspected carriers, as in view of the quantities of anthrax-bearing materials which are offered for export from foreign countries it is exceedingly desirable that some practicable process for general adoption may soon be evolved by which

these important articles of commerce can be effectively disinfected without injury or depreciation of their value.

### QUARANTINE STATIONS.

The Government owns and maintains three quarantine stations for animals imported through the ports of Boston, New York, and Baltimore.

The quarantine station for the port of New York is located at Athenia, N. J., on the Newark branch of the Erie Railroad, 16 miles from New York. The stock-loading chute and yard of the Lackawanna Railroad is not more than a quarter of a mile from the quarantine station, making this road also available for outgoing stock after having been released from quarantine. The station comprises 51 acres of ground and has 23 stables, each of which is inclosed with heavy woven-wire fencing, allowing a fair-sized yard or corral for the stock to enjoy the open air and sunshine in good weather. The stables, most of which are modern brick structures, have a capacity of about 600 cattle.

This station, equipped with complete water and electric-lighting systems, and with three dwellings occupied respectively by the superintendent and two station hands and their families, and three little cottages or quarters for the use of attendants of animals in quarantine, is generally regarded as the most complete and attractive animal quarantine station in the world.

Ruminants and swine arriving at the port of New York, all of which are subject to quarantine, are, after passing a satisfactory inspection by an inspector of the Bureau of Animal Industry, unloaded from the steamer into cleaned and disinfected cars, on a lighter, or into a covered barge which has been similarly treated, and towed to Jersey City, where they are transferred to cleaned and disinfected cars and conveyed to the quarantine station. The station has an unloading platform of earth with a concrete retaining wall of sufficient length to permit of the prompt unloading of trains of considerable length.

The quarantine station for the port of Baltimore is located on the water front within the lighterage area, at Turner, Md., about 5 miles from the steamer docks. The grounds contain 17 acres, recently purchased by the Government; hence all of the buildings, consisting of eight stables, a superintendent's dwelling, and two stock attendants' cottages, are all new. The stables have a concrete base, floors, and side walls, with frame superstructure. They are inclosed by strong woven-wire fencing, forming generous-sized yards, and are equipped with hydrants supplied with water from a deep-driven well and a pressure tank of ample proportions. The capacity of this station is

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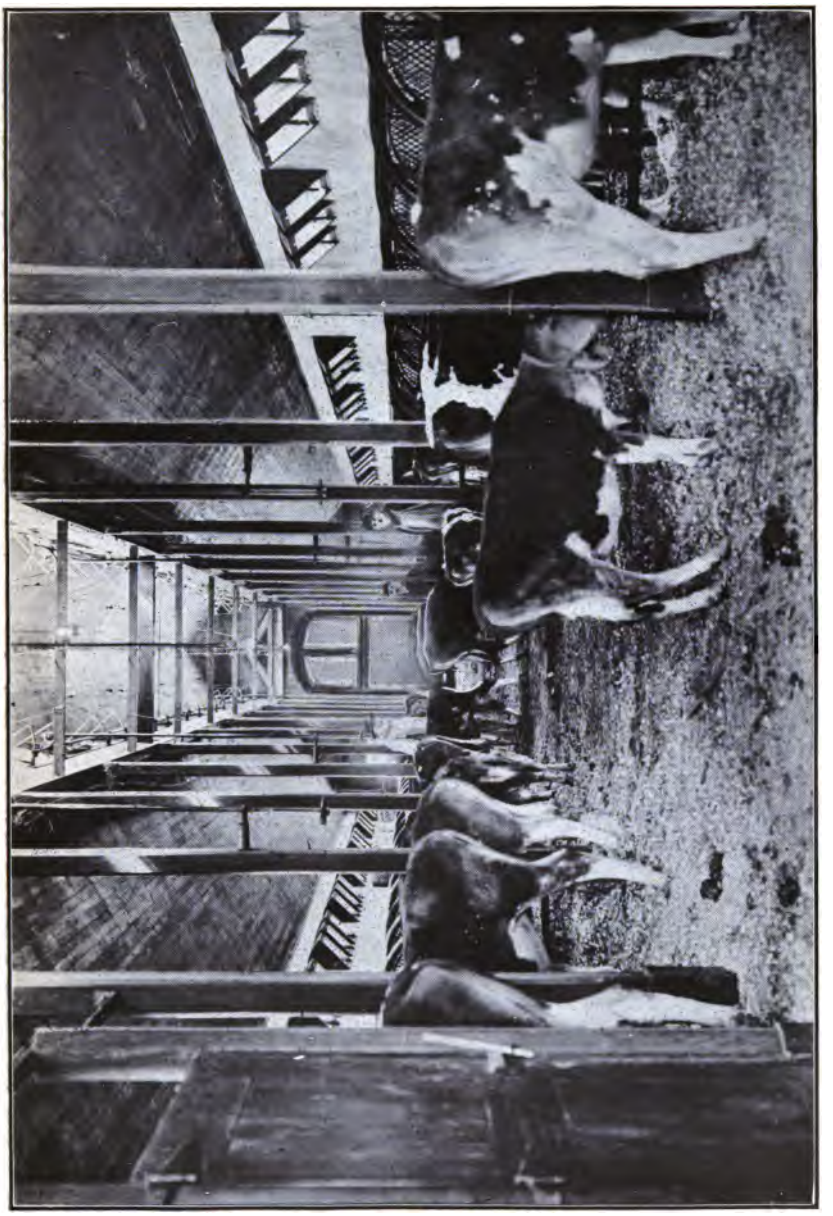

CATTLE IN STABLE AT ATHENIA QUARANTINE STATION.

UNLOADING AN IMPORTATION OF KERRY CATTLE AT BALTIMORE.

The upper picture shows the unloading from the steamer to the dock, and the lower picture from the dock to the lighter for transfer to the quarantine station at Turner, Md. (These cattle were imported by the late Clarence Moore.)

FIG. 1.—TRANSFERRING AN IMPORTATION OF AYRSHIRE CATTLE FROM DOCK TO LIGHTER AT BALTIMORE.

FIG. 2.—UNLOADING THE CATTLE FROM LIGHTER AT QUARANTINE STATION, TURNER, MD.

STABLES AT THE QUARANTINE STATION FOR IMPORTED ANIMALS AT TURNER, MD.

export, such as New York and Boston. The actual number of animals inspected was over a million and three-quarters. In this number there were nearly 300,000 Canadian animals shipped through the United States in transit to other countries, mainly Great Britain. The tuberculin test was applied to over 2,200 cattle and the mallein test to about 34,000 horses and mules. Our exports of meat animals have decreased in recent years because of the heavy demand and high prices of the home market. The United States exports comparatively few live animals to Continental Europe, mainly because our stock is excluded by the policy of some of the European governments.

Besides inspecting live stock for export, the bureau inspects the ocean vessels that carry such animals, and enforces regulations as to fittings, feed, water, attendants, etc., so as to insure that the animals will be carried in a safe and humane manner and reach the other side in good condition. In the five years mentioned 2,733 inspections of vessels were thus made. On arrival at the principal British ports the animals are again inspected by representatives of the Bureau of Animal Industry stationed there, as well as by the British authorities. Statistics show that the losses of live stock in ocean transit, which were formerly quite heavy, have been reduced to a negligible point under the bureau's supervision, and insurance rates have been correspondingly decreased.

The regulations governing the exportation of live stock are issued by the Secretary of Agriculture under authority of the act of Congress approved August 30, 1890, already mentioned, the act of March 3, 1891, entitled "An act to provide for the safe transport and humane treatment of export cattle from the United States to foreign countries, and for other purposes," and the acts approved March 22, 1898, and June 30, 1906, making appropriations for the Department of Agriculture. The regulations now in force are designated as Bureau of Animal Industry Order 139.

The regulations provide that no cattle, sheep, swine, or goats shall be exported from the United States to any foreign country unless and until the same have been inspected and found free from disease or exposure thereto by an inspector of the Bureau of Animal Industry, and that unless the Secretary of Agriculture shall have waived the requirement of a certificate of inspection for the particular country to which such animals are to be exported, no clearance shall be issued to any vessel carrying such animals unless and until a certificate of inspection showing freedom from disease or exposure thereto shall have been issued by the Department of Agriculture. The requirement of a certificate for shipments of such animals to Cuba, the West Indies, Mexico, Central America, and the countries of South America, excepting Argentina and Uruguay,

is waived by the Secretary's order. The places of inspection are designated as follows: Chicago, Ill.; Kansas City, Mo.; Omaha, Nebr.; South St. Joseph, Mo.; National Stock Yards, Ill.; Indianapolis, Ind.; Buffalo, N. Y.; and Pittsburgh, Pa., as well as the following ports of export: Portland, Me.; Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Baltimore, Md.; Norfolk, and Newport News, Va.; Port Royal, S. C.; New Orleans, La,; and Galveston, Tex. Notice follows to the effect that all animals will be inspected at ports of export, regardless of the fact that they may or may not have been inspected at the above-named interior stock yards.

The regulations also provide for the inspection of horses and the issuance of certificates therefor whenever required by the country to which the horses are to be exported.

Export cattle are tagged at central stockyards for identification, at which time records are made as nearly as possible of their points of origin in order that in the event of outbreaks of disease the cattle may be traced back to the locality from which they were shipped.

Railroad companies and proprietors of stockyards and stables located at the ports of export are required to keep separate, clean, and disinfected stockyards and pens or stables for the use of export animals. Shippers are obliged to notify the inspectors in charge of the various yards of intended shipments of animals, together with the numbers and designations of cars in which they are to be shipped. The inspector, after passing such animals, must notify the inspector in charge at the port of export and inspectors located at intermediate cities where the animals may be unloaded for feeding and watering.

In the transportation of export animals from yards to steamers they are not permitted to pass unnecessarily over any highway or to be removed to cars or boats which are used for conveying other animals. Boats transporting export animals to the ocean steamers must first be cleaned and disinfected under the supervision of the inspector of the port, and the ocean steamer before receiving such animals must likewise be thoroughly cleaned and disinfected under the direction of the port inspector. When passage upon or across the public highway is unavoidable in the transportation of animals from the cars to the boats, it must be under such supervision and restrictions as the inspector may direct.

The space on vessels is definitely prescribed for the different kinds of animals, and they must be so placed on the vessel as not to interfere with its proper management or with the efficient working of the necessary lifeboats or with the ventilation. The number of animals and the different kinds which may occupy a single pen is limited, and the sizes of the pens for the different kinds of animals are designated.

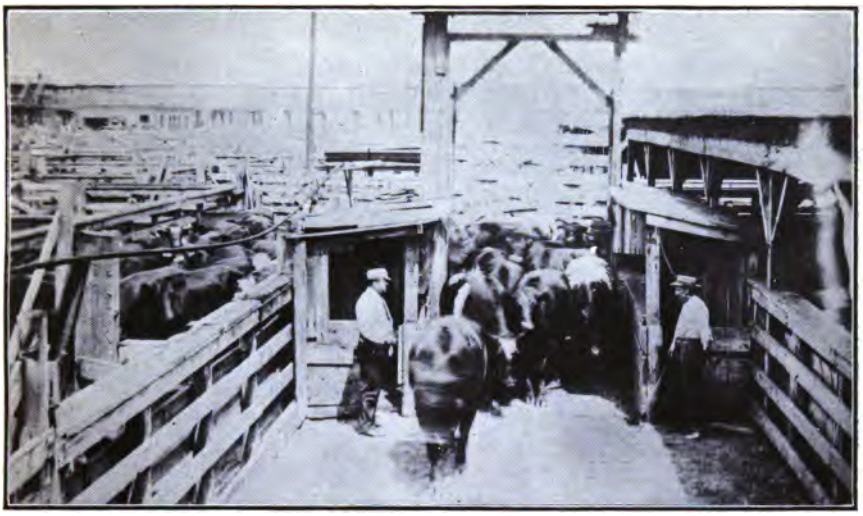

FIG. 1.—INSPECTION OF EXPORT CATTLE AT UNION STOCK YARDS, CHICAGO.

FIG. 2.—EXPORT CATTLE GOING FROM STOCK YARDS TO LIGHTER AT JERSEY CITY.

FIG. 1.—LIGHTER CARRYING EXPORT CATTLE FROM JERSEY CITY TO STEAMER DOCK IN NEW YORK HARBOR.

FIG. 2.—LOADING EXPORT CATTLE FROM LIGHTER TO OCEAN STEAMER.

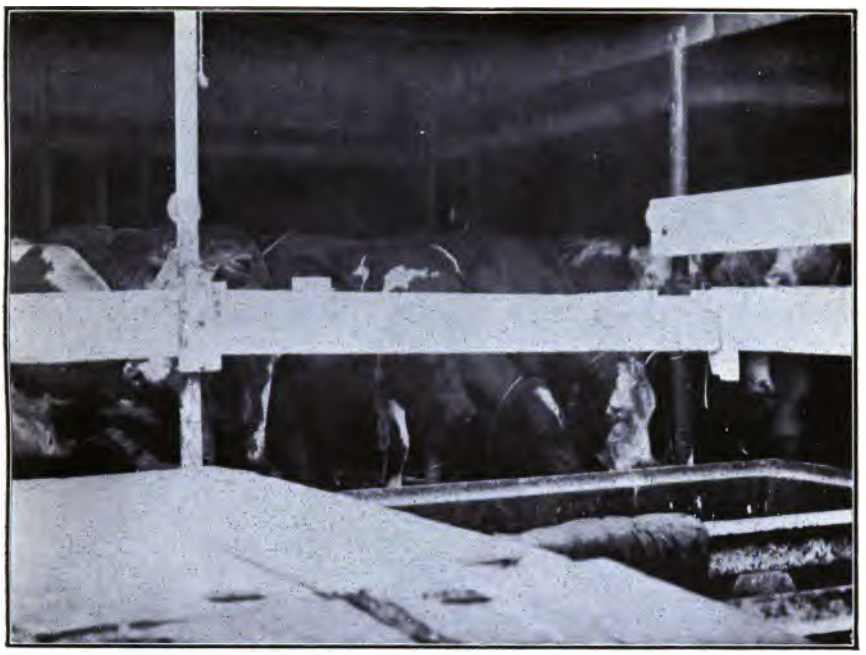

FIG. 1.—EXPORT CATTLE IN PENS ON OCEAN STEAMER.

FIG. 2.—STEAMER SAILING FROM NEW YORK CARRYING EXPORT ANIMALS.

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The specifications for vessel fittings to carry live stock include stanchions of wood and of iron, headboards, footboards, rump boards, hook bolts or clamps, beams, braces, head pipes, division boards, division pipes, flooring, foot locks outside planking, shelter-deck planking, cattle fittings over spar deck, under-deck fittings, troughs, pens at ends of hatches, protection from heat of boilers, casing for steering gear, ventilation, carrying of stock on hatches, width of alleyways, dimensions of lumber and other materials, lighting, feed and water, the number and character of attendants to be employed, rest before loading on steamers, and loading, certificates of inspection, head ropes, etc., as well as the disposition of animals that are injured in transit, and the kinds of fittings that shall be used for each of the various kinds of animals and decks upon which live stock may be carried.

In addition to the regulations of this Government, whose purpose is to insure the healthfulness and desirability of American live stock to the people of importing countries, the more progressive of the latter have their own sanitary and quarantine regulations. Information concerning these foreign regulations can usually be obtained by prospective exporters by applying to the consular representatives of such countries at the United States seaboard ports of export. The names of these consular representatives can be ascertained by reference to a late edition of the United States Congressional Directory (which may usually be found in public libraries) or by writing to the Chief of the Bureau of Animal Industry, Washington, D. C.

# MEASLES IN CATTLE.

By B. H. RANSOM, Ph. D.,
*Chief of the Zoological Division.*

## INTRODUCTION.

The term "measles" as applied in veterinary medicine refers to a condition resulting from the presence of tapeworm cysts or cysticerci in the flesh of food animals. From the standpoint of public health the tapeworm cysts that occur in beef and pork are the most important, as these cysts are the intermediate stages of tapeworms that occur in man. The cysts found in beef when swallowed by man develop into tapeworms of the species known as the unarmed or beef tapeworm (*Tænia saginata*), and those found in pork develop into tapeworms of the species known as the armed or pork tapeworm (*Tænia solium*). Cattle and hogs become infested with the intermediate stage as a result of swallowing the eggs passed in the feces of persons infested with tapeworms. The eggs of the unarmed tapeworm develop into tapeworm cysts only in cattle, and the eggs of the armed tapeworm as a rule develop into tapeworm cysts only in hogs. The eggs of the latter species may, however, develop into cysts in almost any mammal which happens to swallow them, but the hog is by far the most common host of the intermediate stage.

The pork tapeworm is a more dangerous parasite than the beef tapeworm on account of the fact that the intermediate stage may develop in man if the eggs are swallowed, and as the cysts may lodge in vital organs, such as the brain or heart, the consequences are liable to be serious. Fortunately the pork tapeworm and its intermediate stage are very rare in the United States, and this is explained by the fact that in this country raw or imperfectly cooked pork is rarely eaten. Thorough cooking invariably destroys the vitality of tapeworm cysts, and consequently in this country there is little chance that tapeworm cysts in pork will reach a human host alive. Inasmuch as the limited use of raw or imperfectly cooked pork insures the rarity of the pork tapeworm in man, it naturally follows that the intermediate stage in hogs will also be rare, because hogs become infested with the cysts only as a result of swallowing the eggs which occur in the feces of human beings infested with the pork tapeworm.

The beef tapeworm and its cystic stage, unlike the pork tapeworm, are comparatively common in the United States, the explanation

being that raw or rare beef is very frequently eaten. Beef measles at the present time is thus of much greater importance in the United States than pork measles. Although less dangerous than the latter, it is more or less harmful to health, and consequently as a public-health measure the meat of cattle infested with measles must either be excluded from the market, or, in cases of light infestation, after removal of the few cysts found, must be so treated by refrigerating, cooking, or pickling as to render harmless any parasites which may have been overlooked by the meat inspector.

The available figures indicate that nearly 1 per cent of all the cattle slaughtered in the United States at the present time are affected with measles, and this in the aggregate, in addition to exposing to considerable risk of tapeworm infestation the consumer who is not careful to cook thoroughly the beef which he eats, entails a large economic loss as a result of the condemnation of numerous beef carcasses and the more or less expensive restrictions which are placed by the Federal meat-inspection regulations on slightly infested carcasses that may properly be passed for food. Though much of the responsibility for the prevalence of tapeworms in human beings and of the cystic stage of the parasites in cattle rests upon the consumers who do not properly cook the beef which they eat, the lack of proper sanitary precautions in the disposal of human excreta in the localities where cattle are raised and fed is the principal factor in the spread of tapeworm infestation.

## LIFE HISTORY.

When a piece of beef containing a living tapeworm cyst is swallowed the immature tapeworm contained in the cyst, consisting of a head and neck, resists the action of the digestive juices and attaches itself to the wall of the small intestine by means of muscular suckers with which the head is supplied. In from two to three months after the ingestion of the tapeworm cyst the tapeworm (Pl. XII) reaches complete maturity and is then several feet in length, consisting of a chain of segments which, very small in the neck region, gradually increase in size posteriorly and reach a length of two-thirds to three-fourths inch and a width of one-sixth to one-third inch at the posterior end of the body. New segments are constantly forming in the neck region, pushing back the segments formed previously, and the full-grown segments at the posterior end of the body are constantly breaking away and passing out of the intestine. The full-grown segments are filled with eggs, averaging in number about 8,000 in each segment. When it is considered that 10 to 12 ripe segments are commonly passed by a tapeworm patient every day and that a tapeworm may live for many years in the intestine of its host, it is evi-

dent that one tapeworm patient may be the source of infection of hundreds or even thousands of cattle with tapeworm cysts. The feces of such a person deposited in a barnyard, feed lot, insanitary surface privy, or in other improper places are liable to contaminate the feed or water supply of cattle by natural drainage or otherwise, with the result that some of the many thousands of tapeworm eggs present in the fecal material ultimately reach their proper intermediate host. When swallowed by cattle the eggs hatch and the tiny embryos migrate from the alimentary canal, get into the circulation, and are carried to various parts of the body, where they settle down in the intermuscular connective tissues. At the end of two to seven months after infestation the embryos have developed into full-grown tapeworm cysts, ready to complete their development into tapeworms when swallowed by man.

The life history of the beef tapeworm thus consists in an alternation between two hosts—man and ox. The ox becomes infested by swallowing the eggs of the tapeworm with feed or water contaminated by the feces of the human host, and man becomes infested by eating the raw or imperfectly cooked flesh of infested cattle.

## DESCRIPTION OF THE CYSTICERCI.

The cysticerci of the unarmed tapeworm as seen in beef are small vesicles, usually oval in shape, grayish white in color, varying in size from 5 to 15 millimeters or even more in length, and from 3 to 6 or 8 millimeters in width, but rarely larger than the size of a pea. They are surrounded by an outer cyst of connective tissue which is developed by the host, inside of which is the cysticercus proper consisting of a head or scolex, a neck, and a bladderlike structure within which the head and neck are invaginated after the fashion of a glove finger within a glove. (Fig. 1.) The bladder of the cysticercus contains a fluid, and by pressing on the cysticercus after it has been removed from its outer connective tissue cyst the head and neck may frequently be evaginated, and then become clearly evident. Owing to the transparency of the bladder the whitish scolex and neck may, however, be seen while still invaginated. The head bears at its apex an inconspicuous circular depression beneath which is a circular muscular pad (a rudimentary rostellum) which is surrounded by four oval or nearly circular muscular disks or suckers. When the encysted cysticercus is eaten the outer connective tissue cyst and the bladder are digested, but the scolex and neck resist the action of the digestive juices and become the corresponding structures of the tapeworm.

The histological structure of the cysticercus is similar to that of the adult tapeworm. There is a thin outer cuticle of homogeneous structure, beneath which are very fine contractile fibers running transversely and longitudinally, forming a latticework, the trans-

verse fibers being outermost. A more or less well-defined layer of nucleated cells is found beneath the contractile fibers, and the rest of the body is made up of nucleated parenchymatous tissue in which are imbedded muscle and nerve fibers and in which ramify very thin-walled excretory canals of varying size.

On account of the slight thickness of the wall of the caudal bladder the latticework of the fine transverse and longitudinal subcuticular fibers may, as a rule, if the cysticercus is undegenerated and has not lost its transparency, be readily seen with the microscope, and in this

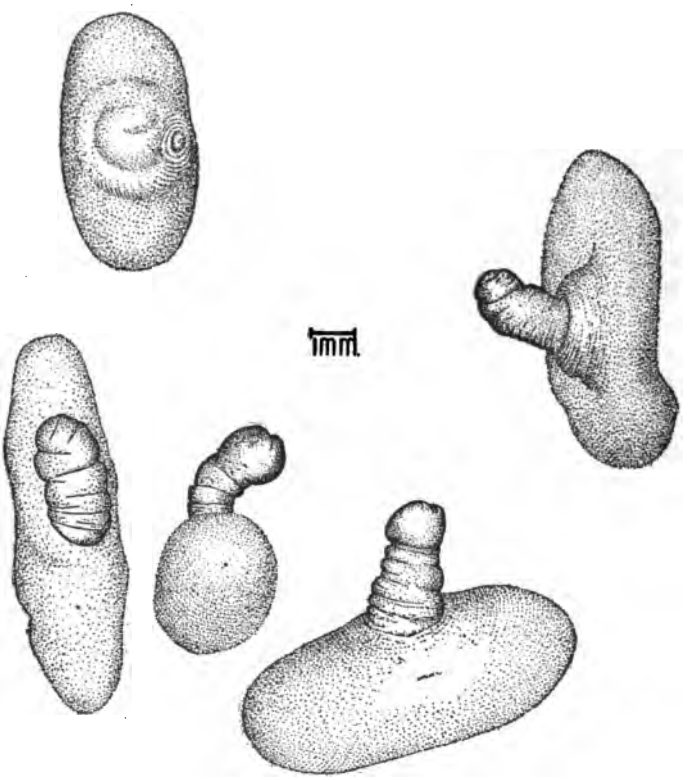


FIG. 1.—Cysticerci removed from cysts. In four of them the head is partially evaginated; in the fifth the head and neck are still retracted within the caudal bladder. (Enlarged. Original.)

part of the cysticercus the irregularly branching excretory canals are also usually evident.

Calcareous corpuscles, which occur in nearly all species of tapeworms, are present, scattered through the parenchyma of the cysticercus, particularly near the surface. They are present in the caudal bladder and head, but are most numerous and of the largest size in the neck. They have a glassy, transparent appearance, and are usually spheroidal, but may be elliptical or kidney shaped. In size they vary

up to about 20 microns in diameter. They are composed largely of a lime salt, but have an organic basis which still persists after treatment with an acid which dissolves out the lime. These calcareous corpuscles when found in the contents of degenerated cysts are a positive proof of the cysticercal nature of the cysts.

### PARTIALLY DEVELOPED AND DEGENERATED CYSTICERCI.

The size and appearance of cysticerci vary with the stage of development. Cysts found by Leuckart 17 to 25 days after experimental infestations measured 2 to 4 millimeters in length and 1.5 to 3 millimeters in breadth. They were whitish in color, as if filled with a chalky or tuberculous material. The envelope of the cysts was composed of connective tissue, and contained an exudate surrounding a clear vesicle, the young bladder worm, 0.4 to 1.7 millimeters in diameter, which protruded when the cyst was cut into. These vesicles were globular, or attenuated at one pole, and in the larger ones the primordium of the head could be seen at the opposite pole. No excretory vessels were found in the bladder worm, but very delicate transverse and longitudinal contractile fibers were present beneath the cuticle in even the smallest cysticerci.

Stroh (1905)[1] has noted that in the case of young cysticerci found in calves of ages varying from 18 days upward the cysts appear as firm, generally elongated nodules of varying size. The cysticerci are either surrounded by a sanguineous serous fluid and then a thick layer of newly formed connective tissue or are associated with a mass of detritus of a more or less caseous consistency, yellow, green, or brown in color, largely composed of blood elements. In the latter instance the mass of detritus and the cysticercus are surrounded by a well-developed cyst wall, and the cysticercus is commonly found near one side of the cyst between its wall and the caseous mass. In such cases, in spite of the caseous nature of the contents of the cyst, the cysticercus itself may show no evidence of any degeneration process.

Hertwig (1891b) by a series of experiments found that the cysticercus becomes fully developed in 18 weeks after infestation. The following table from Hertwig gives the sizes of the cysticerci at different ages from 4 to 28 weeks, and the appearances are shown in figure 2.

[1] References to literature may be found in the Index-Catalogue of Medical and Veterinary Zoology, Bureau of Animal Industry Bulletin 39.

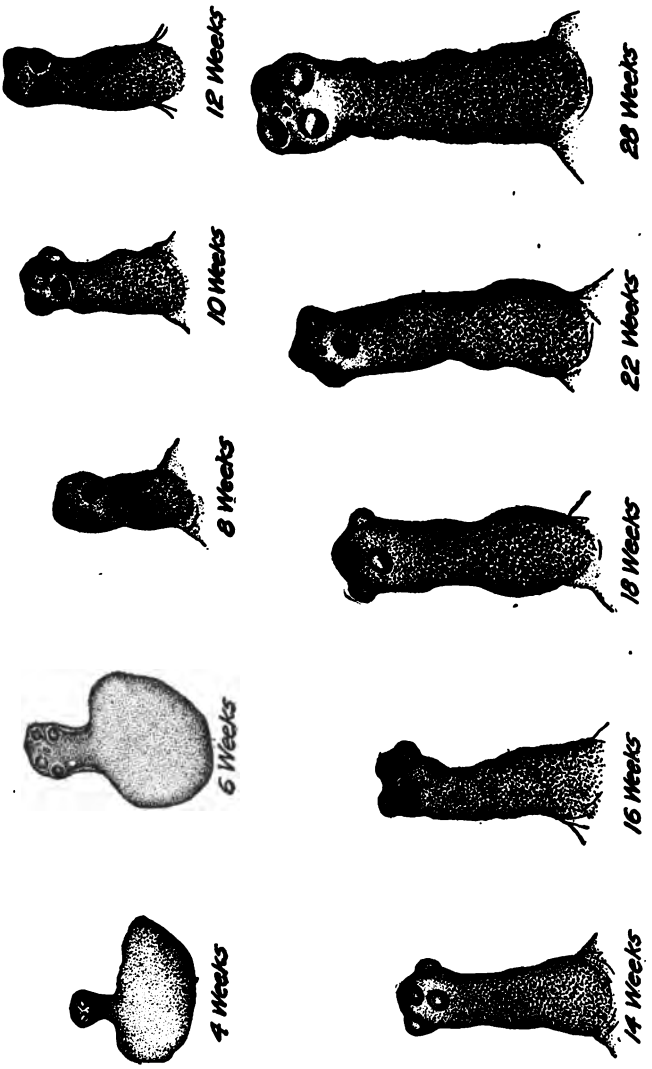


FIG. 2.—Cysticerci in various stages of development from 4 to 28 weeks. (After Hertwig, 1891.)

*Sizes of cysticerci at various ages. (From Hertwig.)*

| Age (in weeks). | Entire cyst. | Cysticercus without connective tissue cyst. | Scolex. | |
|---|---|---|---|---|
| | | | Natural size. | Stretched. |
| 4 | 4.0 by 3.5 mm | 2.25 by 2.25 mm | 0.5 by 0.5 mm | 0.7 mm. long. |
| 6 | 4.2 by 3.5 mm | 3 by 2.5 mm | 1 by 1 mm | 1.3 mm. long. |
| 8 | 4.5 by 3.5 mm | 3.25 by 2.75 mm | 1.5 by 1 mm | 2.9 mm. long. |
| 10 | 5 by 3.75–4 mm | 3.5 by 3.5 mm | 1.75 by 1 mm | 3.3 mm. long. |
| 12 | 5–6 by 3.5–4 mm | 4 by 4 mm | 1.8 by 1 mm | 3.5 mm. long. |
| 14 | 6 by 4.5 mm | 5 by 4.5 mm | 2 by 1 mm | 4 mm. long. |
| 16 | do | do | do | 4.25 mm. long. |
| 18 | 6.25–7 by 4.5 mm | 6 by 4 mm | 2 by 1.25 mm | 5 mm. long. |
| 22 | 6.5–8 by 4.5 mm | 6 by 4.5 mm | 2.25 by 1.75 mm | 5.5–6.25 mm. long. |
| 28 | 7.5–9 by 5.5 mm | 7 by 5 mm | 2.5 by 2 mm | 7 mm. long. |

According to Hertwig, calcareous corpuscles are not present in any considerable number until the cysticercus is 4 weeks old.

Degeneration of cysticerci from causes other than inflammatory processes is said by Ostertag to occur commonly in the case of old, fully developed cysts, but may also occur in cysts at younger stages of development. Hertwig has noted in his experiments that degenerated cysts were to be found as early as four weeks after infestation.

Dead cysticerci in course of degeneration, according to Hertwig, exhibit a cloudiness and thickening of the cyst wall and a cloudiness of the fluid of the cysticercus, which gradually becomes thicker and in which lime salts become deposited, while the originally bright, white color of the neck and scolex of the cysticercus changes to a greenish yellow. In later stages of degeneration the cyst and its contents become semisolid, the contents presenting the appearance of a crumbling, mortarlike mass of a yellowish, sometimes a greenish, color. In some cases, as noted by Kallmann (1888a), in which caseation of the cyst has become well advanced, the grosser morphological structure of the cysticercus still persists.

Ostertag describes the noninflammatory degeneration of cysticerci as beginning with a coagulation necrosis which appears in the caudal vesicle and becomes conspicuous as a caseation, which gradually passes into a calcification. The enveloping cyst of the parasite usually remains intact during this process. Caseation apparently does not always begin with the cysticercus itself as described by Ostertag, inasmuch as cysts may be found with caseous contents in which intact cysticerci are present. In these cases the cysticercus is frequently found at the surface of the caseous mass between it and the cyst wall. Degeneration processes may involve all of the cysticerci in a given animal, but do not always do so. Degenerated cysts in certain parts of the body may be associated with cysts in other parts or even in the same organ which have undergone no degeneration. This is no doubt often the result of more than one infestation, but the presence of degenerated and undegenerated cysts in the same animal can not in all cases be explained in this way.

Cysticerci located in the heart are particularly likely to undergo early degeneration. Occasionally cases are seen in which both undegenerated and degenerated cysts occur together in the heart, and it is quite usual to find degenerated cysticerci in the heart associated with living cysticerci in other portions of the body, particularly in the muscles of mastication. On the other hand, when only degenerated cysticerci are found in the muscles of mastication it is rarely the case that other muscles will contain living parasites.

Ostertag mentions the rather frequent occurrence in beef of cysts varying from the size of an oat grain up to that of a pea, with thick, tough, opaque walls, and with only a small cysticercus. Such cases

he considers as resulting from an unusually strong reaction of the surrounding tissue after the penetration of the tapeworm embryos. The cysticercus except for its small size may be normal or may be attached to the wall of the cyst by a fibrinous exudate resulting from an inflammation of the inner membrane of the cyst. Similar inflammatory processes, according to Ostertag, may also appear in the case of normally developed cysticerci during various stages of development, and may lead to the death of the parasites. Suppuration may occur as the result of the introduction of bacteria which have been carried along by the wandering embryos, or as the result of the excretion of bacteria from the blood into the cysts.

## OCCURRENCE OF BEEF MEASLES.

As already noted, beef measles occurs in the United States in nearly 1 per cent of all cattle slaughtered. Out of 332,446 cattle slaughtered during one month in 57 establishments under Federal inspection, 2,445 were infested with measles, slightly over three-fourths of 1 per cent. In certain European countries measles have been found in as high as 4 per cent of the cattle slaughtered. In the German Empire the percentage of infestation at the present time is said to be somewhat less than 1 per cent.

It has been noted by several observers that bulls and steers show a somewhat higher percentage of infestation than cows, and this is explained by Ostertag by the fact that male cattle are usually slaughtered at a younger age than cows, at which time infestation with measles usually occurs, and also by the fact that measles may in the course of time become degenerated and entirely absorbed, so that old animals which have become infested during their youth may, when slaughtered, show no apparent evidence of the former infestation.

Suckling calves are rarely found infested with measles, but otherwise, as already intimated, measles are less likely to be found in old cattle than in young animals. It is a general rule based upon observations on many kinds of tapeworms that young animals are more liable to infestation with larval tapeworms than old animals, possibly because their tissues offer less resistance to the migration of the embryos and the growth of the cysticerci.

## LOCATION IN THE BODY.

Infestation of cattle with measles is usually slight. The muscles of mastication, according to the experience of meat inspectors in Germany, are by far the most frequently affected. In order of frequency, the heart follows the muscles of mastication, but is much less commonly affected; next in order comes the tongue. Other favorite locations

are the cervical, thoracic, and intercostal muscles and the muscular portion of the diaphragm. The round or rump is said to be not infrequently infested. According to experience in this country the order of frequency is heart, muscles of mastication, diaphragm, and tongue.

Beef measles are rarely found in locations other than the voluntary muscles and heart, but have been recorded as occurring in the lungs, pleura, liver, brain, lymph glands, thymus, supporting cartilage of the nictitating membrane, esophagus, fat, and kidney.

Investigations conducted by Dr. W. N. Neil, of this bureau, show that in 334 cases of infestation the frequency of infestation in various parts of the carcass was as follows:

| | |
|---|---|
| Head muscles | 224 |
| Heart | 225 |
| Diaphragm | 71 |
| Tongue | 52 |
| Esophagus | 2 |

Muscles of the following market cuts:

| | |
|---|---|
| Chuck | 42 |
| Loin | 39 |
| Round | 13 |
| Rump | 6 |
| Shank | 4 |
| Plate | 4 |
| Brisket | 3 |
| Rib | 2 |

In 108 cases the heart was not involved, and in 109 cases the head muscles showed no infestation. The head muscles and heart were both involved in 116 cases, and in 117 cases only a single cyst was found.

The results of a more extensive investigation by bureau inspectors are shown in the following statement which has been compiled from the records of the number and distribution of the cysts found in each retained carcass. In making the examination, the heart, tongue, diaphragm, and muscles of mastication were cut into slices and the remainder of the carcass was divided into 24 market cuts, and all muscular surfaces thus exposed were carefully examined for cysts.

*Tabular statement of the results of an investigation concerning beef measles conducted by inspectors of the Bureau of Animal Industry at 9 meat-inspection stations (57 establishments) during the period of a month.*

| | Number. | Per cent. |
|---|---|---|
| Number of cattle slaughtered (not including calves) | 332,446 | ---------- |
| Total retained for measles (including a few calves) | 2,445 | 0.76 |
| Heart involved | 1,700 | 69.5 |
| Muscles of mastication involved | 1,148 | 46.9 |
| External muscles of mastication involved | 1,090 | 44.6 |

*Tabular statement of the results of an investigation concerning beef measles conducted by inspectors of the Bureau of Animal Industry, etc.*—Continued.

| | Number. | Per cent. |
|---|---|---|
| Internal muscles of mastication involved | 212 | 8.6 |
| Both external and internal muscles of mastication involved | 154 | 6.3 |
| Diaphragm involved | 148 | 6.1 |
| Tongue involved | 74 | 3 |
| Various other muscles involved | 193 | 7.9 |
| Heart involved without infestation of muscles of mastication | 1,279 | 52.3 |
| Muscles of mastication involved without infestation of heart | 727 | 29.7 |
| Heart only involved | 1,164 | 47.3 |
| Muscles of mastication only involved | 669 | 27.3 |
| External muscles of mastication only involved | 614 | 25.1 |
| Internal muscles of mastication only involved (these muscles regularly inspected at only a few establishments) | 33 | 1.3 |
| Both external and internal muscles of mastication, but no other parts involved | 22 | .9 |
| Infestation limited to 1 live cyst in heart | 63 | 2.5 |
| Infestation limited to 1 caseous cyst in heart | 155 | 6.3 |
| Infestation limited to 1 calcified cyst in heart | 616 | 25.2 |
| Infestation limited to 1 live cyst in muscles of mastication | 309 | 12.6 |
| Infestation limited to 1 caseous cyst in muscles of mastication | 89 | 3.6 |
| Infestation limited to 1 calcified cyst in muscles of mastication | 184 | 7.5 |

The following tables taken from Hertwig (1890) show the distribution of the cysticerci in 389 cases of measles found in the Berlin abattoir during the period of a year (1889–90):

| | |
|---|---|
| In the masticatory muscles | 316 |
| In the masticatory muscles and heart | 39 |
| In the masticatory muscles and cervical muscles | 1 |
| In the masticatory muscles and the tongue | 4 |
| In the cervical muscles | 1 |
| In the cervical muscles and tongue | 1 |
| In the tongue | 2 |
| In the tongue and heart | 2 |
| In the thoracic muscles and tongue | 1 |
| In the whole musculature | 22 |

According to these figures the cysticerci, except in 22 cases in which they were distributed throughout the body, were located—

| | |
|---|---|
| In the masticatory muscles | 360 |
| In the heart | 41 |
| In the tongue | 10 |
| In the cervical muscles | 3 |
| In the thoracic muscles | 1 |

It is stated by Reissmann (1901) that 813 cattle infested with measles were passed upon at the Berlin abattoir during the fiscal year 1899. Besides these there were 187 cases in which the cysticerci were calcified. The latter are not included in the following statistics of distribution of the cysts in the carcass:

| | |
|---|---|
| Muscles of mastication only | 767 |
| Inner muscles of mastication only | 266 |
| Outer muscles of mastication only | 488 |
| Heart only | 14 |
| Muscles of mastication and heart | 9 |
| Heart and tongue | 1 |
| Muscles of mastication, heart, and tongue | 6 |
| Muscles of mastication and tongue | 3 |
| Muscles of mastication, heart, and pectoral muscles | 1 |
| Muscles of mastication, heart, and diaphragm | 1 |
| Heart, muscles of shoulder, and abdominal muscles | 1 |
| In the whole musculature | 10 |
| Monocystic carcasses | 754 |

A summary of the statistics which have been given of meat inspection at Berlin for the years 1889 to 1899, excluding the fiscal year 1891–92, for which the records are very incomplete, shows that out of 4,539 cases of beef measles the muscles of mastication only were infested in 4,159 cases (over 91 per cent), and that these muscles were involved in 4,428 cases (in which are included certain cases in which it was not definitely stated that these muscles were infested, namely, cases noted as having the entire musculature infested); over 97 per cent of all cases therefore showing measles located in the muscles of mastication.

The difference in the distribution of the parasites as noted in Germany and in this country is difficult to explain, but may be the result of different methods of inspection. For example, it is possible that in Germany a more careful examination is made of the muscles of mastication than in this country, and on the other hand that more attention is given to heart inspection in the United States than in Germany. Another plausible explanation which would account in part for the discrepancy between the German and American figures is that the German statistics as to the distribution of the cysts in the carcass exclude numerous cases in which only a few degenerated cysts are found; and the heart being a common location of degenerated cysts, it is reasonable to suppose that many if not practically all of the excluded cases are cases in which the heart is involved, and consequently that if these cases were included in the statistics the percentage of heart infestation would be much higher.

## METHODS OF INSPECTION FOR DISCOVERING CYSTICERCI

In inspecting beef carcasses for the presence of cysticerci it follows from what has already been stated relative to the frequency of the parasites in different parts of the body that the muscles of mastication and the heart should receive special attention, in addition to which, however, other muscular parts which are rendered visible and readily accessible in the operation of slaughtering should also be examined.

Where practicable the meat and the tongue should be removed from the head prior to inspection, and a careful examination made of the muscles of mastication, which should be sliced so as to expose as much of the muscular tissue as possible. At the same time the visible portions of the tongue and attached muscles should be inspected. If it is not practicable to remove the head meat and the tongue at this stage, the tongue should be so loosened as to expose the internal muscles of mastication. These muscles and the external muscles may then be inspected in situ. Incisions should be made in the muscles of mastication, cutting parallel with the lateral surfaces of the lower jaw bone. In the case of the masseter muscle the cut should be continued far enough to leave the separated portion of the muscle attached only near the orbital border. By reflecting this piece a clear view may be had of the cut surfaces of the muscle. In slicing the masseter the section should pass through the muscle midway between the superficial and intermediate fasciæ, or else through the deep portion of the muscle beneath the intermediate fascia. The latter cut makes the subsequent removal of the cheek meat from the bone more difficult, and hence in regular routine inspection the former cut is preferable (Pls. XIII–XV).[1]

In inspecting the heart the pericardium should be opened and the surface of the heart examined. Both ventricles should be opened with a lengthwise incision and an examination made of the cut surfaces and of the interior. In order to avoid soiling the surface of the heart unduly with blood, the incision should be made with the left ventricle uppermost. The wall on the lower side of the heart as held in this position need not be cut through, and if left intact will serve as a hinge upon which the heart is opened for examination.

That a mere superficial examination of the heart is insufficient is shown by a report from Dr. B. P. Wende of this bureau, who had an examination made of 4,324 hearts, none of which showed external evidence of infestation. Ninety-three of these hearts when cut into pieces were found to contain measle cysts. Dr. A. O. Lundell and Dr. J. S. Kelly of this bureau have also called attention to the occurrence of measles deep seated in the heart when none were evident superficially.

In the case of calves less than 6 weeks old it is generally considered unnecessary to make a special inspection for measles, and the German regulations provide that such inspection may be omitted. In calves of this age any cysticerci present will be small, only partially developed, and incapable of developing into tapeworms; and it is very exceptional that any cysticerci will be present in such young animals, as they do not have the same opportunities of becoming infested as

[1] Plates XIII to XVI are from photographs by Drs. Thomas White and A. English, of the meat-inspection force of the Bureau of Animal Industry at South Omaha, Nebr.

MATURE TAPEWORM (TÆNIA SAGINATA).

The tiny head and slender anterior portion of the worm are seen in the upper left-hand portion of the picture. (Natural size. Original.)

COW'S HEAD, WITH CUT IN MASSETER MUSCLE, SHOWING LIVE CYST OF CYSTICERCUS BOVIS.

LIVE CYST IN MASSETER MUSCLE OF COW'S HEAD.

(Slightly enlarged, from same specimen shown in Pl. XIII.)

NUMEROUS CALCIFIED CYSTS IN MASSETER MUSCLE OF COW'S HEAD.
(Slightly reduced.)

FOUR LIVE CYSTS IN BEEF HEART.

Arrows indicate locations of cysts.

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older animals which are past the sucking stage. In cases which have been traced it has been found that the calves were pail fed and that the attendants were infested with tapeworms. The transfer of eggs from the attendants' hands soiled with fecal matter to the mouth of the calf was a very natural result under the circumstances.

## DIAGNOSIS.

Fully developed, undegenerated cysts are readily recognizable as such. The bladderworm when freed from its outer connective tissue cyst presents characters which clearly demonstrate its nature (fig. 1). The thin-walled caudal bladder and the invaginated head and neck which may sometimes be caused to protrude by pressure between the fingers are plainly evident features visible to the naked eye. In dead cysticerci it is usual to find the head partially or completely evaginated. Microscopically the numerous calcareous corpuscles of the neck and the four suckers of the head may be seen. *Cysticercus tenuicollis*, the larval stage of the marginate tapeworm of the dog, which occurs in cattle, sheep, hogs, and other animals, may be distinguished from *Cysticercus bovis*, the beef measle bladderworm, by the fact that it does not occur in the striated musculature but only under the serous membranes or, in young stages, in the liver. Furthermore, *Cysticercus tenuicollis* possesses a crown of hooks on the head, whereas *Cysticercus bovis* is without hooks.

Echinococcus cysts, which rarely occur in the musculature, may sometimes, when of small size, be confused with beef measle bladderworms, but are distinguishable from the latter by the fact that they do not possess a simple scolex, and are either without heads or contain brood capsules inclosing several or many heads, which are smaller and otherwise quite different from that of *Cysticercus bovis*. Microscopically the cuticula of an echinococcus is seen to be thick and laminate. This lamination is usually evident in the cuticle of degenerated echinococci as well as in those which have undergone no degeneration, and is a character not seen in the thin homogeneous cuticula of cysticerci.

In the case of partially developed or degenerated cysticerci a definite diagnosis of their nature is frequently difficult. The former, however, may be identified as cysticerci if in the exudate contained in the surrounding envelope of newly formed connective tissue there is found a small, clear vesicle, in whose wall is a latticework of very delicate transverse fibers and longitudinal fibers, visible under a high power of the microscope. The exudate may be a more or less sanguineous fluid, or caseous in consistency, and green, yellow, or brown in color.

In the case of degenerated cysticerci in which the process of degeneration has not gone beyond caseation, the parasites may still retain

their characteristic form and structure, but usually it is not possible to demonstrate the caudal bladder, the scolex with its suckers, and other grosser characters intact, and this is especially true after calcification has set in. Under such circumstances a provisional diagnosis of cysticercus may be made on the ground that connective tissue cysts of the size of a pea or small hazelnut (usually the maximum size of *Cysticercus bovis* cysts) or smaller, with caseous or calcified contents, located in the voluntary muscles or heart of cattle, can scarcely be anything but cysts of *Cysticercus bovis*. The finding of calcareous corpuscles in the contents of such cysts is conclusive evidence that they are cysticercus cysts.

Sarcocystis cysts (*Sarcocystis blanchardi*) which occasionally occur in the esophagus of cattle might carelessly be mistaken for cysticerci, but their appearance is characteristically different and their contents consist largely of very numerous falciform spores about 15 microns long. These cysts when occurring in locations other than the esophagus are usually almost microscopic in size and hence not likely to be confused with cysticerci.

Actinomycotic tubercles occurring in the tongue may in certain cases be confused with cysticerci, but may be differentiated from the latter by the following characters. Within the connective tissue wall which delimits the tubercles from the surrounding tissue may be seen small pale-yellow masses, which on microscopic examination are found to be made up of the radially arranged mycelia of the ray fungus.

Kieckhäfer (1896) has described a case of lymph cysts resembling cysticerci. These cysts located in the hyo-glossus muscle varied in size from that of peas to hazelnuts. Their nature, however, was immediately apparent upon incision. Dr. U. G. Houck of this bureau has also called attention to the not uncommon occurrence of lymph cysts on the fasciæ of the masseter muscles. (See Pl. XVIII.)

## VITALITY OF CYSTICERCI.

Beef cysticerci, as determined by various observers, die when exposed for 5 minutes to a temperature of 44° to 60° C. (112° to 140° F.). In practice, however, to insure the death of the cysticerci it is necessary to use higher temperatures and to apply the heat for a longer time, for the reason that heat does not penetrate readily into large pieces of meat. For the sake of safety cooking should be continued until the meat is well done and presents a uniform gray appearance when cut across. This change of appearance does not occur until the temperature has reached 60° to 70° C. (140° to 156° F.), and it thus affords a means of determining whether the cooking has been sufficient to kill any cysticerci which may be present.

In salt solutions of the strength ordinarily used in pickling, isolated cysticerci die in 24 hours. Owing to the uncertainty as to the length of time required for the thorough penetration of pickling solutions into pieces of meat, it seems unsafe to depend upon pickling as a means of hastening the death of cysticerci, and as a rule infested beef placed in pickle should not be considered safe to eat until 21 days have elapsed.

Decomposition of the meat does not necessarily destroy the vitality of cysticerci, as they have been found still alive in badly decomposed meat.

Cysticerci die naturally within a certain time after the death of the host, and in some cases may all be dead within 2 weeks. Investigations by various authors have shown that 3 weeks may be accepted as a safe limit within which all cysticerci will have perished.

Freezing destroys the vitality of beef cysticerci rather quickly, and it seems safe to assume that all cysticerci will be dead if meat in pieces the size of regular market cuts is solidly frozen and kept at a temperature of not more than 12° F. for 6 days. In the experiments which have been made with reference to freezing, rather small pieces of meat have been used. It is well known that small pieces of meat will freeze much more rapidly than large pieces, and it is also known that various organisms which are unable to withstand a rapid lowering of temperature to below the freezing point commonly survive freezing when the temperature is lowered very gradually. It is, hence, uncertain whether freezing, which has been found to destroy the vitality of cysticerci in small pieces of beef in a few days' time, would prove equally efficacious in the case of large pieces. Accordingly, in the case of large pieces, such as quarters and sides of beef, it is not justifiable, on the basis of our present knowledge, to assume that all cysticerci will be dead in less than 21 days.

### DISPOSAL OF BEEF INFESTED WITH CYSTICERCI.

Since beef cysticerci when taken into the alimentary canal of human beings develop into tapeworms that have more or less injurious effects upon their hosts, creating digestive disturbances and discomfort, withdrawing nutriment, and sometimes giving rise to serious nervous affections, it is evident that beef infested with living cysticerci is a harmful article of food. If the carcass is heavily infested, showing evidence of a general distribution of cysticerci in large numbers throughout the musculature, or, without reference to the number of parasites, if the flesh is watery or discolored as a result of the parasitic invasion, it should be condemned.

If the infestation is moderate, the carcass may be rendered into tallow. In Germany, which has a "Freibank" system, moderately infested carcasses are allowed to pass for food provided they are cut

into pieces of about 5½ pounds each, and provided they are refrigerated for 3 weeks or are cooked or pickled. Such pieces, however, must either be placed on the Freibank or sold under declaration.

Slightly infested carcasses may be passed for food provided they are refrigerated for 3 weeks; and there is also no objection from a sanitary standpoint to passing such carcasses after they have been pickled for 3 weeks or after the meat has been cooked. Refrigeration, however, furnishes the most satisfactory means of safeguarding against slightly infested carcasses, as there is less depreciation in their value than when they are cooked or pickled. The fat may be passed for food without refrigerating provided it is melted at not less than 140° F., which is a sufficiently high temperature to destroy the vitality of any cysts which might have been overlooked.

## ERADICATION OF MEASLES.

An efficient meat inspection is an important means of eradicating the tapeworms of man and their intermediate stages in cattle and hogs. By excluding from human consumption all meat infested with cysticerci these tapeworms (*Tænia saginata* and *T. solium*) would soon become extinct in the human race, and in the absence of the tapeworm stage there would of course be no further infestation of cattle and hogs. There is, however, no practical method of meat inspection which would absolutely insure the freedom of all inspected meats from cysticerci. Moreover, in the United States meats intended solely for local consumption within the boundaries of the State in which the animals from which they are obtained are slaughtered are not subject to inspection by Federal authorities, and hence, as inspection is rarely conducted by local authorities, much uninspected meat is consumed. Under these conditions there is a large loophole through which measly beef and pork may find their way to the consumer. Furthermore, no system of meat inspection could be expected to extend to meats killed for home consumption on farms and ranches, and it is in these places that the occurrence of tapeworms in human beings is of the greatest importance, for it is there that the passage of the parasites from the human host to cattle and hogs is most likely to occur.

Consequently, in order to reduce to a minimum the chances of becoming infested with tapeworms, beef or pork should not be eaten unless thoroughly cooked. Even with this precaution it is conceivable that infection might occur; for example, a careless cook might by using the same knife for cutting raw meat and bread transfer a cysticercus from the meat to the bread, with which it might be eaten unnoticed.

Perhaps the most important prophylactic measure of all is the proper disposal of human feces. The common carelessness in this

PORTION OF HEART OF STEER INFESTED WITH CYSTICERCI.

Haines. del.

BREUKER & KESSLER CO. PHILA.

LYMPH CYSTS ON SUPERFICIAL FASCIA OF MASSETER MUSCLES OF CATTLE.

Haines. del.

BREUKER & KESSLER CO. PHILA.
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matter results in the spread of tapeworm infection from human beings to animals, as well as in the spread of a number of diseases of man, such as hookworm disease and typhoid fever.

Every human being infested with a tapeworm is a peripatetic center of infection, and inasmuch as each gravid segment of a tapeworm contains several thousand eggs, and as several segments may become gravid and be expelled every day during a period which may extend over several years, it may easily happen that hundreds of cattle or hogs may become infested from a single tapeworm patient, if this person lives in a rural district where live stock are raised and kept. Human excreta should therefore not be placed where live stock can have access to them, or where there is any possibility of resultant contamination of feed or water. It is very unhygienic for human beings to defecate in buildings, yards, or pastures occupied by live stock; and if this is done by persons infested with tapeworms, the infestation of cattle (or hogs, in the case of the armed tapeworm) is almost certain to result. The question of the proper disposal of human dejecta on the farm is fully discussed in Farmers' Bulletin 463, which may be obtained free on application to the Secretary of Agriculture.

A person knowing himself to be infested with a tapeworm should of course get rid of the parasite as soon as possible. By so doing he will add to his own health and comfort and will avoid the risk of spreading infection to live stock and indirectly to other human beings. Treatment, however, should be undertaken only under the care of a physician, as tapeworm remedies are liable to be dangerous or inefficacious if not properly used.

From the foregoing it is evident that the prevention of tapeworm infection in human beings and of measles in cattle and hogs is comparatively simple and may be accomplished by the following means:

1. An efficient meat inspection.
2. Proper cooking of meat before it is eaten, particularly if there is any doubt of its freedom from infestation with measles.
3. Disposal of human feces so that live stock can not have access to them and so that there is no possibility of contaminating the feed or water supply of live stock.

# MALTA FEVER, WITH SPECIAL REFERENCE TO ITS DIAGNOSIS AND CONTROL IN GOATS.

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AND

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## INTRODUCTION.

On the island of Malta there has been endemic for an indefinite period a febrile disease of the inhabitants, termed "Malta fever," also known as "Rock," "Mediterranean," or "undulant" fever, and vernacularly called "slow," "dust," or "goat" fever. This infection was so exceedingly prevalent among the British soldiers and sailors stationed on the island that in 1904 a commission was appointed by the British Government, under the supervision of an advisory committee of the British Royal Society, to investigate the possible sources of infection and advise methods for its control. The commission has since investigated the disease in all of its phases in a most exhaustive manner, and as early as 1905 [1] was led to consider that the milk from the native goats was an important if not the main factor in the dissemination of Malta fever among human beings. It was found that the goats were not only susceptible to artificial infection, but that about 50 per cent of them acquired the disease naturally, and that the organisms producing the disease were eliminated in their milk and urine. It was then decided to investigate the milk of such infected though apparently healthy goats, with the result that in Malta 10 per cent of the goats were found to be eliminating the specific coccus in the milk, and this milk when fed to monkeys even for a day was able to produce typical attacks of Malta fever which ran a course parallel to that of the disease in man. The only logical conclusion which could be formulated from this work was that the Maltese goats were carriers of the virus of Malta fever and were one of the principal means of transmitting the disease to human beings through the ingestion of their milk. All the available evidence points to contaminated food as the vehicle by which these goats become infected with the virus of Malta fever. Furthermore, it has been shown that the urine of infected goats

[1] Report of the Commission on Mediterranean Fever, pt. 3, p. 2. London, 1905.

and of ambulatory cases in man at times contains the causative agent, *Micrococcus melitensis*, so that goats feeding on material that has come in contact with such urine (which is not at all infrequent by the usual method of handling these animals) are readily infected. Thus the frequency and the method of infection in goats are quite readily explained.

Other proofs of the transmission of Malta fever to man through the milk of infected goats are forthcoming from a number of experiences which have been noted since regulations were enforced in infected districts looking to the elimination of goat's milk as a source of infection. Thus the disease is said to have practically disappeared from Gibraltar following the removal of the infected goats. The affection does not occur among the convicts of the civil prison at Malta who are not allowed milk, but Malta fever is nevertheless present in the district where the prison is located. All fresh milk now being supplied to the soldiers at Malta is pasteurized, with the result that Malta fever among them has been reduced 90 per cent, while the disease has not abated among the civil population which continues to use infected milk.

## DEFINITION.

Malta fever designates a specific febrile septicemic affection of man characterized by protracted, remittent fever, and is usually associated with anemia, rheumatic pains, and swelling of the joints. It is caused by the *Micrococcus melitensis.*

The manifestations in susceptible animals differ greatly from those in man, and in these the affection may often persist without being noticed.

## HISTORY.

The first account of the existence of the disease was furnished by Marston. In 1859 he observed it among the inhabitants of Malta, and gave a complete description of the fever, especially its clinical manifestations. In 1879 Tonaselli made a report of a fatal epidemic of the disease at Catania. Likewise Veale described the fever in patients of Gibraltar, Malta, and Cyprus. The next important step in the knowledge of the disease was reached by the discovery of the causative organism (*Micrococcus melitensis*) by Bruce in 1887.

In 1904 a commission was appointed by the British Government for the purpose of investigating the disease, and very valuable information was obtained from the accurate and careful work of this commission, especially relative to the mode of infection in human beings, this work showing that the goat can be safely incriminated as the principal source of the affection in human beings.

In 1897 Wright established the agglutination test as a suitable diagnostic method for the determination of the disease, and this has constituted the principal procedure for the determination of obscure cases in animals as well as clinical cases in man. A contribution relative to the diagnosis of the disease, especially with reference to the application of the complement-fixation test for the diagnosis of Malta fever, was recently made by the present authors.[1]

## OCCURRENCE.

The disease has been endemic on the island of Malta for a very long period, but its presence in other parts of the world has likewise been recognized from time to time, and at the present time its occurrence in tropical and subtropical localities has been noted in almost every country, and quite extensively especially in countries along the Mediterranean. It has been reported from Spain, Gibraltar, Italy, the Mediterranean islands (Balearic Islands, Corsica, Sardinia, Cyprus, Crete, and Grozo), Turkey, China, India, Palestine, the Philippine Islands, North Africa, and South Africa. Of the South American countries, it has been reported from Venezuela, Brazil, Uruguay, Cuba, and Porto Rico.

In the United States the disease has been reported as occurring in the Mississippi Valley. However, authentic cases are not recorded from which the existence of the disease could be considered as positively established. In 1905 Craig reported a case of Malta fever in Washington, D. C., which occurred in a nurse, the disease in this case having probably been contracted from nursing infected soldiers who had returned from the Philippine Islands. He reported 9 cases among soldiers, the infection in these cases probably also originating in the Philippine Islands.

In 1905 the Department of Agriculture imported a number of Maltese goats from the island of Malta for the purpose of obtaining foundation stock for a milch-goat industry in this country. Certain facts in the history of their voyage to this country, which came to our attention about this time, suggested that some of the imported goats were infected with Malta fever virus. The presence of this affection among the Maltese goats was subsequently demonstrated by Mohler and Hart,[2] both bacteriologically and by a series of agglutination tests conducted in this laboratory. As a result of these tests it was deemed advisable to destroy not only the imported goats, which during these investigations were kept in quarantine, but also their offspring, as it was found that even the kids gave positive

[1] Mohler, John R., and Eichhorn, Adolph. A contribution to the diagnosis of Malta fever. Journal of the American Medical Association, Apr. 13, 1912, vol. 58, No. 15.

[2] Mohler, John R., and Hart, George H. Malta fever and the Maltese goat importation. Twenty-fifth Annual Report, Bureau of Animal Industry, 1908, p. 279. Washington, 1910.

reactions to the agglutination test in many instances. At least one person who voluntarily drank the milk of these goats contracted a typical case of Malta fever. Some of the conclusions recorded in this report were the following:

1. It has been definitely demonstrated that the *Micrococcus melitensis*, the organism of Malta fever, has a more or less passive existence in the body of Maltese goats, exercising its pathogenic effect when it gains entrance to the human body.

2. These goats, when carriers of the virus of Malta fever, are one of the important factors, if not the principal factor, in the dissemination of this disease, through the ingestion of their milk by human beings.

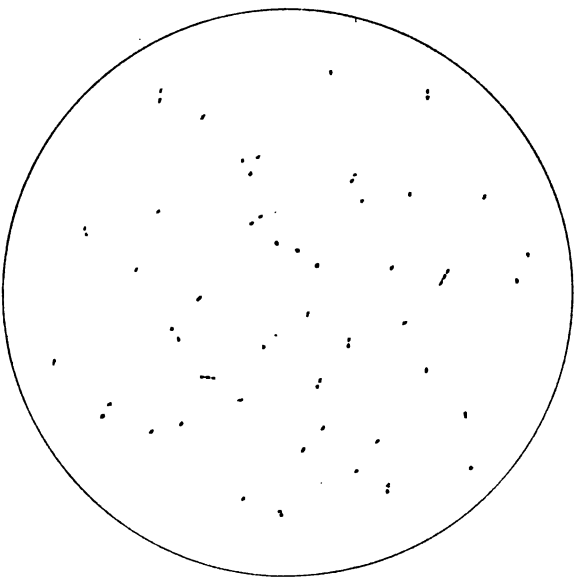
3. Goats infected with Malta fever eliminate the causative agent of the disease in both the milk and the urine.

4. All the available evidence points to contaminated food as the vehicle by which the goats become infected with the organism of Malta fever. The urine of infected goats and of ambulatory cases in man at times contains the *Micrococcus melitensis*, so that normal goats feeding on material which had come in contact with such urine are readily infected. Thus the frequency and the method of infection in goats are quite easily explained.

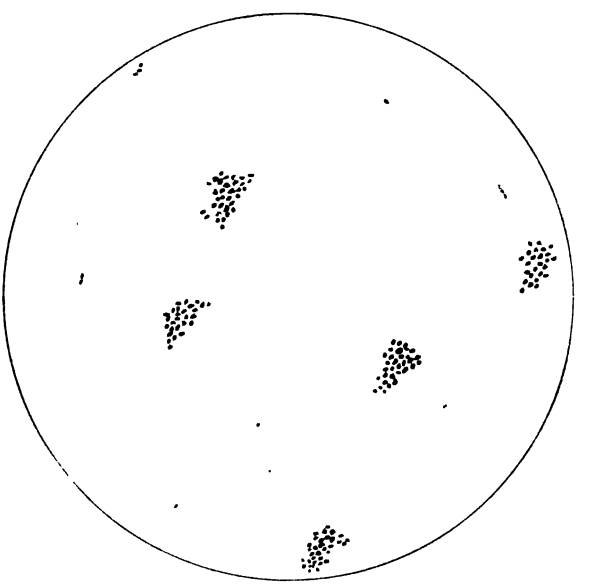
By the recent investigations of Gentry and Ferenbaugh [1] the existence of Malta fever in Texas has been definitely established. Its occurrence in human beings has been demonstrated bacteriologically among certain families in the goat-raising sections of Texas, and since goats have been incriminated as carriers of the infection to man the sera of a number of these animals in the infected localities were subjected to the agglutination test with positive results. The isolation of the *Micrococcus melitensis* from these goats was not successful, and the agglutination test was therefore relied upon for the diagnosis of Malta fever in these animals. The occurrence of the disease in Texas has been substantiated by the writers, who obtained positive results not only with the agglutination test, but also with the complement-fixation test of sera from goats sent to the laboratories at Washington from the infected localities of Texas and New Mexico.

The existence of this disease in Texas is of great moment, inasmuch as the general opinion has prevailed that the United States is free of Malta fever, and that the only occasions when the disease has appeared in this country were isolated instances, occurring through importation. However, from a careful investigation in the infected districts it seems evident that Malta fever, which is also known locally as mountain fever and slow typhoid fever, has existed in Texas and New Mexico for at least 25 years; that the disease has always made its appearance among people connected with goat raising; that entire families have been taken sick with the disease on goat ranches; that many of the goat ranches have had one or more cases

[1] Journal of the American Medical Association, vol. 57, nos. 9, 11, 13, and 14. Chicago, 1911.



1.—Micrococci from bouillon culture 24 hours old. × 1,000.



2.—Agglutination of micrococci with blood serum from Maltese goat. × 1,000.

MICROCOCCUS MELITENSIS, THE CAUSATIVE AGENT OF MALTA FEVER.

(From Twenty-fifth Annual Report.)

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of the fever among the people connected with them; that in some years there are numerous cases of the disease, while in other years only a few cases will appear. The affection appears usually after the kidding season, during the months of April, May, and June, when the people are in closer contact with the goats. It is stated that the Mexican goat herders are quite infrequently affected, but this may be due not to any natural immunity but to the fact that the Mexicans always boil the milk before drinking it, while the Americans use the milk raw.

The origin of the disease in that section is indefinite, but it is claimed that the affection prevailed in Texas when the common goat was the only goat in the country and long before any of the improved breeds of goats were imported from South Africa, where Malta fever has been found to exist. Most of the goats in the infected districts are of the Angora breed, and none of them were imported from South Africa via Mexico. All the goats imported from Mexico during the last 10 years were the common Mexican goat, almost all of which were brought in for slaughter or grazing purposes through the ports in the lower Rio Grande country.

## ETIOLOGY.

The *Micrococcus melitensis* is a very small, round, or slightly oval coccus about 0.4 micron in diameter, occurring singly or in pairs, less frequently in short chains. Involution forms are frequently observed, especially in artificial cultivations. Some of the authors have considered the organism as a short bacillus, which view is principally based on its appearance in stained preparations. In fresh material obtained from infected individuals, however, it invariably appears in the coccus form, and the various involution forms are usually obtained only from older cultures. Capsule and spore formations are never observed.

The *Micrococcus melitensis* is nonmotile and possesses no flagella. In hanging drop preparations it shows an active Brownian movement, which, however, is not true motility.

The *Micrococcus melitensis* may be stained with all ordinary basic anilin dyes, but is Gram negative. Methylene blue and fuchsin give the best results. (See Pl. XIX.)

The organism grows very slowly, even at incubator temperature, and requires a faintly acid medium. The optimum temperature is 37° C.; a slow growth, however, may also take place at room temperature and at 42° C. Under 6° and over 45° C. the growth ceases. The micrococcus is aerobic but may also grow anaerobically.

On agar plates specific colonies appear after 1 to 2 days, which are hardly perceptible to the naked eye. After 2 to 3 days the individual colonies appear as small dewdrops. If the colonies are not very

numerous they may reach a diameter of 1.5 millimeters after 8 days. The single colonies are round, almost spherical; their surface is smooth and shows a uniform granulation. In the center of each colony an oval darker spot is noted which appears most strikingly in the deeper colonies. The colonies of about 4 days' growth are whitish opaque and in a strong light they appear somewhat opalescent. Later the color changes from a deep amber to a pale brown or even darker color.

In stab and also on slant agar the growth at first consists of single colonies; later they coalesce and appear as a moist lustrous growth which at first is yellowish, later becoming a darker color. On gelatin plates at room temperature the growth is extremely slow, so much so that even at the end of the first week the colonies are hardly perceptible to the naked eye. The colonies resemble those on agar plates. The gelatin does not liquefy. In gelatin stabs very small round colonies appear in about 5 days along the entire stab, the colonies close to the surface becoming larger in about 10 days and taking up a yellowish brown color.

In bouillon the growth appears only after the second day, when the fluid becomes cloudy. After 3 days the growth appears more luxuriant in the upper layers than in the lower parts of the tube. After a week a white precipitation forms on the bottom of the tube and continues to increase, and after 4 weeks the greater part of the medium is clear and the deposits increase considerably. The deposit consists principally of shorter and longer chains of the micrococcus. Neutral litmus milk gives a prolific growth in 24 to 48 hours, the alkaline reaction continuing to increase. Litmus milk also gives luxuriant growths. Its consistency is not changed, but the alkalinity develops very rapidly, and the milk takes on a pronounced light-blue color.

Potatoes are not suitable for the cultivation of the organism, as the growth appears as a moist spot hardly perceptible to the eye on the surface of the potato. On alkaline potatoes the growth is stronger, showing after 4 days a light or yellowish deposit.

### TENACITY.

Cultures of the *Micrococcus melitensis* kept under favorable conditions will retain their virulence for several months, even for years. Exposed to moist heat at a temperature of 60° C., they die in 10 minutes. It requires a temperature of 90 to 95° C. of dry heat to destroy their virulence. Direct sunlight destroys them in a very short time (one or two hours). In diffused light they resist for seven days. The organism shows considerable resistance against drying. Cover-glass preparations covered with the organism when dried proved active even after 75 days. A solution of 1 per cent carbolic

acid destroys the cocci in 5 to 15 minutes, while a one-half per cent solution of carbolic acid will destroy their virulence in 1 hour. (Eyre.) Pasteurization of infected milk for 20 minutes at 145° F. is sufficient to destroy the organism; therefore milk pasteurized for the destruction of typhoid and tubercle bacilli will contain no living *Micrococcus melitensis*.

## PATHOGENICITY.

Experimental inoculations have shown most of the different species of animals to be susceptible to the disease. The affections in the different species, however, are not indicated very perceptibly, and the presence of the disease in some of the animals can be only noted by the continuous elimination of the organism in the secretions and excretions. This applies specially to infections of ruminants, which, while harboring the infection, may pass the organism for months, even years, without manifesting any indications of abnormal health. This fact in itself is of great importance when the control of the disease is considered.

Monkeys inoculated subcutaneously or intravenously with cultures of the *Micrococcus melitensis* will develop a condition which clinically greatly resembles the manifestations of the disease in human beings. After a period of incubation of 2 to 5 days a rise in temperature is noted, which continues to persist for about 10 days. The fever usually is at its height in the afternoon and evening, and toward morning it drops, the animals appearing brightened. Besides the fever, the animals appear depressed and have no appetite, and there are diarrhea and emaciation. After the subsidence of the febrile period a stage without fever follows. This again is followed by a severe febrile attack, which when subsiding usually is followed by recovery. Complications and unexpected death may result at any time during the disease. The autopsies reveal only a swollen spleen of a dark red color, while all other organs appear apparently normal. The micrococcus may be isolated from all organs.

Guinea pigs and rabbits are also susceptible to subcutaneous, intravenous, and intraperitoneal injections, although in some instances they fail to manifest any perceptible symptoms in spite of the continuously progressing emaciation that may extend for weeks or months, depending on the virulence of the organism with which they have been inoculated.

Goats, sheep, cattle, and horses are also susceptible to infections, but in these animals the artificial infection is rarely followed by disturbed general health, although the presence of the disease is indicated by the organisms passed by these animals in the urine, and in females in the milk.

In man accidental infection, sometimes with fatal results, has occurred on a number of occasions among laboratory workers from pure cultures of the organism.

The natural infection is especially of importance in regard to the dissemination of the disease, since the affection in man can only be satisfactorily controlled by a comprehensive knowledge of the modes of infection. It is generally conceded that the milk of goats can be safely incriminated as the principal carrier of the natural infection and as the chief source of infection in man. This is especially substantiated by the fact that the extensive occurrence of the disease among English soldiers stationed at Gibraltar was practically eliminated by prohibiting the consuming of raw goat's milk. Nevertheless, other sources of infection must also be considered, inasmuch as there are authentic cases on record in which the disease appeared in families in which goat's milk had not been consumed in any form, and cases in Texas studied by Gentry and Ferenbaugh indicated in several instances other modes of infection than through goat's milk, although in all instances goats were kept on the premises where the disease occurred in man.

In consideration of the persistence of the *Micrococcus melitensis* in the milk of infected goats for long periods, this source of infection is without doubt the principal mode of dissemination of the disease to man. The dissemination of the disease among animals, however, must be attributed to other sources, and in these cases direct contact, as well as infection through urine and excreta, come into consideration. Examination of the urine from infected animals shows the presence of great numbers of the cocci, and their appearance in the urine continues invariably for the periods in which the organisms are found in the milk. Experiments carried out in this line showed that the urine may be incriminated as the principal source of infection in the propagation of the disease among goats, and probably in those instances where the disease appears in human beings not drinking goat's milk the infection has been accomplished through this medium.

The food and the ground of the premises in which goats are kept are readily contaminated with the urine of infected animals, and in this manner the infection may be contracted by healthy animals either through ingestion of the virus or through inhalation of the dust containing the organism. Artificial experiments conducted in order to establish whether such dried infected dust would be infectious proved positive, although the experiments relative to dust infected with urine from infected animals were negative. The infection may also enter the body through wounds, which was proven by artificial experiments, as it was found that such a mode of infection

is readily possible by the application of small quantities of culture to abrasions on the skin of monkeys.

The principal point of entrance of the organism under natural conditions, however, appears to be through the alimentary canal. This must be considered especially since experience has shown that the most frequent infections which are noted occur from the drinking of infected milk. The experiments which were undertaken in this line by the commission appointed by the British Government offer sufficient conclusive evidence of this mode of infection, as it was shown that one single feeding of goats' milk containing the micrococci even sparingly was sufficient to give rise to the disease. Infection by contact, inhalation, or by biting insects is doubtful and may be almost disregarded, especially in the natural infections, and it is safe to accept the alimentary method of infection as the one great danger by which the disease is propagated.

This having been established, infected goats' milk and probably the swallowing of contaminated dust would come first into consideration as transmitters of the infection, and, as already stated, with the preventive measures directed against the use of goats' milk in infected localities the disease has been controlled to a great extent. To illustrate the effectiveness of such preventive measures it will be sufficient to cite that in the months of July, August, and September, 1905, when the prohibition against goats' milk had not been enacted, 258 cases occurred among the soldiers of Malta, while in the same months in 1906, after the enforcement of this measure, the number fell to 26. Bruce in his work on Malta fever expresses the opinion that nine-tenths of all the cases of Malta fever are due to infection by goats' milk.

## ANATOMICAL CHANGES.

The anatomical changes are principally observed at autopsies held on human beings, as well as to some extent on experiment animals, since during the natural course of the disease in animals it is only exceptional that deaths result from the disease. As already stated, animals, especially goats, infected with the disease may harbor the infection for months, even years, without showing the slightest indication of disturbed health. The principal lesion occurring in men or experiment animals dead of the disease is the character of the spleen, which is always enlarged; besides, there may be changes indicative of the febrile stage and of the circulation of toxins in the blood. The lungs may show edema, sometimes with small bronchopneumonic areas. The urine is normal in appearance and color and in some instances may contain albumin. The specific organism is present very frequently in the urine, especially in the protracted

cases. The lymph glands may be swollen, but usually fail to show any characteristic changes.

## SYMPTOMS.

From the standpoint of sanitary control of the affection in animals the symptoms offer scarcely any characteristic indications of the presence of the disease in goats or other susceptible domestic animals. The observations of the numerous infections occurring in goats, also in experimentally infected animals, fail to show any signs indicative of the disease. On the other hand, in man there is always a pronounced symptom complex by which the presence of the disease may be suspected and diagnosed.

During the experiments on the diagnosis of the disease in goats carried out by the authors, the artificially infected goats were carefully observed in order to note any changes which might occur. Temperatures were taken twice daily, and the animals were also given careful clinical examinations at frequent intervals. The infected animals showed a rise in temperature of 0.5° to 0.7° C. on the second and third days after the infection, respectively, but outside of that no symptoms whatsoever were noted. The animals appeared in continuous good health, the appetite being normal, and they continued to gain in weight. The successful inoculations of the animals nevertheless were established on the fifth and seventh days respectively after the infection, inasmuch as on those days the first indication of a positive agglutination reaction was obtained. The *Micrococcus melitensis* was also isolated at these times from the blood and urine of those animals.

This appears to indicate the period of incubation after artificial infection. This, however, is by no means the length of time under natural conditions, since in the natural mode of infection much smaller numbers of organisms are taken by the animals, and probably as a result the time of incubation is considerably longer. The period of incubation in human beings is said to range from six days to several months.

Some authors have observed that in affected goats the milk sours shortly after it has been drawn, but this is by no means a constant manifestation in the disease. The most important symptom which is observed among goats affected with Malta fever is the frequency of abortions which result in the course of the disease. Some authors estimate that expulsions of immature fetuses occur in 50 to 90 per cent of the pregnant animals, and abortions in affected animals reoccur also during the succeeding and even at the third gestation following the infection. Abortion is most frequent in the fourth month, but may occur any time from the second month to the full term of pregnancy. If the fetus is carried to the full term it is

usually born dead or dies within a very short time. The symptoms which precede the abortion are not as well marked as those which are noted in cattle during outbreaks of infectious abortion. After aborting the animals recover in the ordinary time, but not infrequently catarrh of the sexual organs, mammatis, and even postpartum infections result.

The symptoms in other animals are likewise most frequently imperceptible, and the presence of the disease can be determined only by the demonstration of the specific organism in the blood, secretions, or excretions.

The symptoms in human beings are usually pronounced and give rise to a more or less severe affection. The most striking symptom is a febrile attack with periods of normal temperatures. The duration of these periods varies considerably during the disease. The fever may be remittent or in other cases intermittent; again it may be continuously high or low, and at all stages of the disease the type of the fever may change. The course of the disease in human beings also varies, as it may be very acute from the onset, the fever setting in with chills and rise of temperature from 40° to 41½° C., associated with severe headache and pain in the back, and a general ill feeling. The pulse and respirations are affected in accordance with the height of the fever, although the acceleration of the pulse is not proportional to the rise of the temperature. Diarrhea may first appear, followed later by constipation. The more frequent subacute form, however, usually commences slower and is more gradual in its development. In this form rheumatic pains in different parts of the body are observed. After a few days from the first indication of disturbed health the evening temperature rises to from 39° to 41½° C., with remissions in the morning. The fall in temperature is always associated with profuse perspiration. The first attack of fever may last from 1 to 5 days, and after an interval of 10 to 14 days with absence of fever a relapse occurs which corresponds to the first attack, except that it is usually of a shorter duration. This condition may continue for a period of 9 months or even longer. Cases have been observed in human beings, however, in which the symptoms were totally absent and the disease was indicated only by the presence of the infective organism in the urine, and likewise by the presence of agglutinins in the blood.

## COURSE AND PROGNOSIS.

The course of the disease in animals always appears to be protracted, as cases have been noted in goats when the elimination of the specific organism extended over a period of more than a year. The determination of the disease in infected animals can only be

established by periodical examinations of the blood and urine of the infected animals, the absence of the *Micrococcus melitensis* in such cases being indicative of the absence of the disease. The serum tests could not be considered in this regard, inasmuch as the specific immune bodies may be present in recovered animals for a long time after the subsidence of the infection.

The course in human beings may extend for from six weeks up to a year, and cases have even been observed in which relapses occurred for three years, depending on the acute or chronic character of the disease.

The prognosis in animals is always favorable as far as the health of the animals is concerned. In human beings the mortality is estimated at 3 per cent, deaths usually occurring from a weakness of the heart, or less frequently from hyperpyrexia.

## DIAGNOSIS.

With respect to the manifestations of the disease in animals, especially in goats, the clinical diagnosis or even post-mortem diagnosis is almost impossible. In this regard the bacteriological examination may prove satisfactory, although negative results obtained in such instances do not necessarily exclude the possibility of the presence of the disease. Very frequently the animals affected harbor only a small number of cocci, hence bacterioscopical examinations, as well as cultural and test inoculations, may be negative. The isolation of the organism appears to be most satisfactory from the urine and the milk, while the blood does not afford the same opportunities, as it usually contains the organism only in sparing numbers.

When inoculation of test animals is undertaken the diagnosis even in such instances must depend upon the bacteriological examination as well as upon the serum tests of the test animals.

The numerous investigations which have been carried out relative to the methods of diagnosis of Malta fever appear to be quite uniform as to the reliability of the agglutination test for the diagnosis of this malady. Nevertheless, the results of some of the investigators prove that the agglutination value is by no means constant in the suspected patients, and it has further been established that human beings, as well as goats, although apparently recovered from the disease, give an agglutination value of the serum indicative of Malta fever even years after the infection. It has also been found that the agglutination value in the presence of this affection is by no means constant, and occasionally it may even fail to indicate the presence of the infection.

Furthermore, there appears to be a diverse opinion among the investigators of Malta fever relative to the height of the agglu-

tination value which should be considered as indicative of an infection. Thus, by some writers an agglutination of 1:10 is considered as sufficient proof of the presence of the disease; others claim 1:20, while still others require 1:30 as the lowest value for a positive diagnosis. During the quarantine of the goats imported from Malta, which has previously been referred to, the Bureau of Animal Industry conducted a number of experiments in order to determine the agglutination value of normal goat serum for the virus of Malta fever. It was found repeatedly that such sera from healthy goats born and raised at the experiment station gave an agglutination value of 1:40. Hence in the tests of the quarantined Maltese goats an agglutination value of 1:70 within a time limit of 1½ hours was required for a positive diagnosis. Kolle and Hetsch [1] state that the agglutination test is indicative of Malta fever only when its value represents a titre of at least 1:100.

In consideration of this difference of opinion regarding the agglutination value of sera from suspected and infected patients, it was deemed advisable to carry out preliminary experiments to determine whether the complement-fixation test could be utilized for the diagnosis of Malta fever. Sera of a large number of goats from the bureau's experimental farm at Beltsville, Md., were obtained and tested both with the agglutination and complement-fixation tests.[2]

In the meantime two goats were subcutaneously injected with one-half cubic centimeter of a washed agar culture of the *Micrococcus melitensis*.

The agglutination test was applied by both the microscopical and the macroscopical methods, but the best results were obtained from the macroscopical method carried out by a procedure similar to that practiced for the diagnosis of glanders. For this purpose the test fluid is prepared from a 4-days-old glycerin-agar culture of the *Micrococcus melitensis* by heating the culture at 60° C. for 1½ hours, which is then washed with carbolized salt solution, filtered, and diluted to a desired density. This is established by comparative tests with sera of known agglutination values determined by microscopical agglutination. Once the titre of the agglutination fluid has been established by these comparative tests, the proper density of a newly prepared fluid is readily obtained by pouring a sample of each into two beakers of equal size up to the height of about 2 centimeters. The density of the old and new fluids may then be compared by placing the beakers on print, preferably engraved print, and observing the legibility of the print through the fluid. The dilution of the new fluid is continued until the density becomes

[1] Die experimentelle Bakteriologie und die Infektionskrankheiten mit besonderer Berücksicktigung der Immunitätslehre. 1911.

[2] It should be understood that this flock was not infected with Malta fever.

similar to that of the old fluid. The numerous comparative tests which have been undertaken with the microscopical and macroscopical agglutination tests show that a reliable uniformity has always been obtained.

The technique of the macroscopical agglutination test is carried out as follows: The suspected serum is diluted with carbolized salt solution in the proportion of 1 to 40 (0.5 cubic centimeter serum to 19.5 cubic centimeters carbolized salt solution). This constitutes the basic dilution, and from this all the dilutions of sera are made in test tubes in such a way that with the added 2 cubic centimeters of test fluid (bacilli emulsion) the desired dilutions are obtained. Thus, 0.8 cubic centimeter of basic dilution added to the 2 cubic centimeters of test fluid would give a serum dilution of 1 to 100. Any number of different dilutions can be prepared in this manner. The rack containing the test tubes is then placed in the incubator for one-half hour, after which the tubes are removed and centrifugalized for 10 minutes at 1,600 revolutions a minute. The test tubes are then returned to the rack without further incubation and the results read after 1 to 2 hours. The sharply circumscribed lentil-shaped sediment in the center of the bottom of the test tube with cloudiness of the upper portion of the fluid indicates the failure to agglutinate, while an irregular veil-like clumping of the sediment over the bottom of the tube with a clearing of the upper part of the fluid is indicative of agglutination. The racks are so constructed that they have a conical opening on the lower shelf into which the bottom of the test tubes fit, and through these openings the reaction is plainly visible, especially when placed on a dark background. A more detailed description of the technique of this method as applied to glanders, together with drawings showing the above-described appearances of the sediment in both positive and negative reactions, will be found in an article in the Twenty-seventh Annual Report of the Bureau of Animal Industry for 1910, pages 345 to 370, reprinted separately as Circular 191.

This method of agglutination would come especially into consideration if large numbers of sera were to be tested, and particularly if it were desired to examine the blood of a great number of goats in certain localities for the control or possible eradication of the disease.

The sera of healthy goats from the experimental farm and that of 20 suspected goats from Texas and 20 similar goats from New Mexico, as well as the sera from the artificially infected animals, were carefully tested by the microscopical agglutination method and also by the method just described. The results showed practically no variation in these two methods, and in consideration of the simplicity of the macroscopical method as described it would appear

that it should be given the preference over the microscopical method, especially in cases where a large number of individuals are to be tested.

In the meantime experiments have been conducted with the complement-fixation test for the diagnosis of Malta fever with sera from normal as well as from infected animals. The hemolytic system consisted of sensitized rabbit serum, serum from a guinea pig, and a 5 per cent suspension of washed sheep corpuscles. An antigen was prepared from 4-days-old glycerin-agar cultures, and after heating for 2 hours at 60° C. it was agitated for 4 days in a shaking machine. The extract was then placed in centrifuge tubes and centrifugalized for 2 hours at a speed of about 2,500 revolutions a minute. The clear fluid was drawn off and preserved with 10 per cent of a 5 per cent carbolic-acid solution. A titration of the antigen was then undertaken in order to establish the smallest quantity which would no longer prevent hemolysis. A dilution of 1:50 was found to be the proportion of antigen to be used in the tests.

The goat serum to be tested was inactivated at 56° C. for 30 minutes. The complement was titered in each instance in order to establish the necessary smallest quantity required to produce complete hemolysis. Of the sera to be examined, 0.2 and 0.1 cubic centimeter, respectively, were used, and the customary control tubes were always included in the test. Thus, in routine testing, four tubes were taken for the test proper, the first pair receiving 0.1 cubic centimeter of serum and the second pair 0.2 cubic centimeter. The second and fourth tubes served as controls for the serum, in order to establish that the serum without the antigen would not produce a fixation of complement.

The sera from the goats at the experimental farm failed to give a fixation in any instance, although in several cases it was observed that the hemolysis resulted slowly, and sometimes a very small quantity of blood corpuscles settled to the bottom of the tube, but in all these instances the reaction was the same in all four tubes; namely, in the tubes for the test proper, as well as in the control tubes. Of the sera examined from the suspected cases sent from Texas, 4 gave positive complement fixation, and in all these instances the fixation was complete, even in the tube in which only 0.1 cubic centimeter of serum had been used, while 16 other examinations of sera from the same source gave negative results.

The agglutination test of the sera from the cases in which a fixation of the complement was obtained showed a value in one instance of 1:50, in two 1:15, and in the fourth it failed to agglutinate even at 1:10. The remaining 16 cases failed to agglutinate in the proportion of 1:10.

In the tests made with the sera of the New Mexican goats only one case gave a positive reaction to the complement-fixation test.

The sera of the goats which had been artificially infected were drawn every day from the time of infection and examined both by the agglutination and the complement-fixation tests. On the fifth day an agglutination of 1:40 was obtained, which on the subsequent days was marked at 1:500 and reached a height of 1:2,000, continuing to give an agglutination value of over 500 for the two months after infection, during which period the animals have been under constant observation. A partial complement fixation was first obtained on the seventh and ninth days, respectively, and from that time on a perfect fixation was obtained in all instances. In these tests even smaller quantities than 0.1 cubic centimeter gave a fixation; thus, in establishing what would be the smallest quantity of serum which would give a complete fixation, it was found that on the twenty-second day after the infection in one goat 0.04 cubic centimeter of serum gave a complete fixation.

From the results of these investigations it appears that the complement-fixation test can be utilized for the diagnosis of Malta fever, and in consideration of the fact that the agglutination test is not always reliable for such purposes the complement fixation would be of great advantage as an adjunct in the diagnosis of this malady.

## PREVENTION AND TREATMENT.

Since the nature of the disease was established attention has been directed toward establishing immunity by serum treatment as well as by vaccines. The investigations in this line on test animals have shown that test animals inoculated with dead organisms fail to give protection to subsequent virulent infections.

Wright aimed to produce a horse serum by treating goats and horses with *Micrococcus melitensis*. About 50 cases were treated with such horse serum, but the published results do not offer conclusive proof of the effectiveness of this serum.

The present authors have also experimented on infected goats with a vaccine prepared along the lines of antityphoid vaccine. The goats were injected four times at intervals of one week with such vaccine containing increasing numbers of killed bacilli. The blood was drawn from time to time from these animals, and cultures were also made at different times from the urine and the blood. The results showed that during the time of treatment the urine still contained virulent organisms. The serum tests both with the agglutination and complement fixation continued to give positive results, although four weeks after the last vaccine injection no bacilli could be longer demonstrated by culture or other methods.

The practical value of the vaccine treatment is very doubtful, inasmuch as it would be almost impossible to isolate strictly all animals giving a positive serum reaction and subject them to a vaccine treatment. Therefore it appears that hygienic and preventive measures are of far greater value in the control and possible eradication of the disease.

The control of the disease in a herd could be best accomplished by subjecting the blood serum of all animals to the combined agglutination and complement-fixation tests and destroying all reacting animals. Further, care should be taken to have all newly purchased animals tested and permit their introduction into the herd only if the absence of the disease has been established. However, even the strictest measures in this direction would give no assurance of a positive safeguard against the introduction of the disease, as the virus may be carried by other means than by goats, such as dogs and rabbits.

Measures for the control of the disease would, of course, have to be adopted in accordance with the extent of the infection. Should the serum tests indicate only a moderate spread of the disease in a locality, measures for eradication could be adopted by killing all animals giving a positive serum test. On the other hand, such a procedure could hardly be considered in localities where the disease affects a large percentage of the animals, as, for instance, among the goats on the island of Malta. In such cases the problem of eradication would be very difficult, and the infection of man could be best guarded against by the pasteurization of all goats' milk and the removal of the corrals and kidding pens from proximity to dwellings. The sanitary conditions around the goat ranches should be improved. The goat pens as a rule are very close to the ranch house (see Pls. XX and XXI), and the goat manure has been accumulating in these pens ever since goats have been kept therein. Frequently the goat bedding ground is around the yard fence. The water supply is usually from wells and small streams, and in many instances these may readily become contaminated from the goat pens.

As in the case of all other infectious diseases, thorough disinfection of the infected corrals, pens, and utensils should be carried out in order to prevent the recurrence of the disease. As a disinfectant the compound solution of cresol, carbolic acid, or chlorid of lime may be used by mixing 6 ounces of any one of these chemicals with 1 gallon of water. One of the approved coal-tar sheep dips might also be used to advantage in a 5 per cent solution (6 ounces of dip to 1 gallon of water). After removing the manure and litter the disinfectant solution should be applied liberally to all part of the pens, and sufficient lime may be added to the solution to make the disinfected area conspicuous.

In localities where the disease is prevalent an educational campaign dealing with the necessity of heating the milk, as is done for the prevention of milk-borne typhoid fever, would greatly aid in the prevention of infection in man.

No thorough investigations have yet been undertaken as to the extent of Malta fever among the goats of Texas, New Mexico, and possibly in other States, and until this is determined it is impossible to decide upon a definite line of procedure for the control and eradication of the disease.

Although the disease has no active effect on goats, its eradication must be considered from the standpoint of public health, and in this respect it is of the highest importance, since there is a tendency at the present time among physicians to advise the drinking of goats' milk for children and invalids.

A HERD OF MILCH GOATS IN TEXAS, SHOWING PROXIMITY OF BED GROUNDS TO DWELLING.

A HERD OF MILCH GOATS IN TEXAS, WITH PENS ADJACENT TO OWNER'S HOME.

A HERD OF 600 MILCH GOATS IN TEXAS, WITH DAIRY IN THE BACKGROUND.

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# INFECTIOUS ABORTION OF CATTLE AND THE OCCURRENCE OF ITS BACTERIUM IN MILK.

## I.—INTRODUCTORY STATEMENT.

By A. D. MELVIN,
*Chief of the Bureau of Animal Industry.*

In a paper presented at the annual meeting of the American Veterinary Medical Association on August 24, 1911, by Drs. E. C. Schroeder and W. E. Cotton, of the Experiment Station of the bureau, under the title "An Undescribed Pathogenic Bacterium in Milk," attention was called to a peculiar pathological condition frequently found in guinea pigs that were injected with milk and afterwards permitted to live six weeks or longer.[1] This paper under a different caption and with slight modification appears in the following pages.

The microorganism to which the pathological condition in the guinea pigs was due was isolated, and it was definitely proven that it, and it alone, was the cause of the lesions, which, in their gross anatomical appearance, resembled the lesions of tuberculosis in guinea pigs so much that a distinction between the two pathological conditions was not certainly possible without microscopic examination. The microorganism was studied as carefully as the facilities for bacteriological work at the Experiment Station permitted.

As a matter of course, the discovery of the peculiar microorganism, a small bacterium, aroused considerable interest in the bureau, and it was not long before Dr. John R. Mohler, Chief of the Pathological Division, called attention to the close resemblance of the organism found in milk to the bacterium of infectious abortion, in which latter he was interested because he was making investigations concerning contagious abortion of cattle.

Experiments were at once undertaken, by Mohler on one hand and by Schroeder and Cotton on the other, to settle definitely the question of the identity of the two bacteria. In February, 1912, the experiments reached the stage where it was absolutely certain that the bacillus isolated from milk—the organism that causes a slowly progressive disease in guinea pigs with lesions macroscopically like those of tuberculosis—is identical with the bacillus of infectious abortion of cattle. A preliminary note was therefore issued March 2, 1912, as Circular 198 of the Bureau of Animal Industry, announcing

[1] See Proceedings of the American Veterinary Medical Association, 1911, pp. 442–449. Also American Veterinary Review, Nov. 11, 1911, pp. 195–206.

that the bureau's investigations had demonstrated the identity of the bacterium discovered in the milk of cows and the organism widely recognized as the etiological factor in infectious abortion of cattle.

Those who are familiar with the descriptions that have been given of the organism of infectious abortion of cattle will easily recall how contradictory they are in many respects. Whether or not this is due to differences in the technique used by different investigators can not be said, but it is interesting to refer to the matter here, because the identity of the bacillus in milk and the organism of infectious abortion of cattle studied by Mohler would have been decided much earlier if one difficulty, now settled, had not stood in the way, namely, that the tests made at the Experiment Station at first showed the bacillus from milk to be a Gram positive organism while the other bacillus was found by the Pathological Division to be Gram negative. The bacillus, whether obtained from milk or from other sources, is now looked upon as being Gram negative.

The final test to establish the identity of the bacilli was the similarity obtained by Mohler and Traum in the Pathological Division and by Schroeder and Cotton at the Experiment Station, working independently, in the lesions produced in guinea pigs inoculated respectively with the milk bacillus and the bacillus of infectious abortion, as well as the identity of the two organisms shown through the agency of the complement-fixation test.

In what respect the discovery of the bacillus of infectious abortion of cattle in the milk of cows is important can readily be seen by reading the paper by Schroeder and Cotton, which follows. In that paper it is pointed out that it is questionable what may be the practical importance of this bacillus, now demonstrated to be the bacillus of infectious abortion, occurring with a high degree of frequency in market milk. The fact that this organism was found in 8 samples of market milk among 77 samples tested (over 11 per cent), and in the milk distributed by 6 among 31 dairies (over 19 per cent), leaves no doubt that we are dealing with a phenomenon that is ominously serious in its significance for public health.

We do know that the organism causes abortion in cattle and some other animals, and that it causes progressive lesions of a serious character in some experiment animals; and although we do not know what effect it may have on human beings, we can not afford to assume that they are not affected by it. This bacillus may prove to be another source of danger in the use of raw milk as food, and may furnish an additional reason for taking advantage of the safeguard afforded by pasteurization.

The paper by Schroeder and Cotton follows, after which is given a paper by Mohler and Traum reporting the work done in the Pathological Division.

## II.—THE BACILLUS OF INFECTIOUS ABORTION FOUND IN MILK.

By E. C. SCHROEDER, M. D. V., and W. E. COTTON, D. V. M.,
*Of the Bureau of Animal Industry Experiment Station, Bethesda, Md.*

### CIRCUMSTANCES LEADING TO DISCOVERY OF THE ORGANISM.

Several years ago, at the Experiment Station of the Bureau of Animal Industry at Bethesda, Md., we made a series of tests relative to the occurrence of virulent tubercle bacilli in ordinary city milk, with special reference to their intermittent occurrence in milk vended by dairies from which tuberculous samples had been obtained with previous tests. In the course of these investigations many guinea pigs were given intraabdominal injections of milk and afterwards kept alive somewhat longer than is commonly believed to be necessary for well-marked lesions of tuberculosis to develop. When the guinea pigs were eventually killed some of them showed lesions on post-mortem examination that could easily be mistaken for tuberculosis, but which our experience with tuberculosis in guinea pigs helped us to distinguish as probably another disease, especially as careful microscopic examinations failed to reveal acid-fast bacilli, which are, as a rule, abundant and not difficult to find in the tuberculous lesions of guinea pigs.

We soon discovered the disease to be transmissible through subcutaneous inoculations of affected tissue from guinea pig to guinea pig, but our efforts to cultivate a supposedly existing specific microorganism and our attempt to find an organism in the lesions under the microscope were unsuccessful.

After our interest in the subject had somewhat abated it was actively restimulated during a study concerning the influence of tuberculin injections on the elimination of tubercle bacilli, with milk and otherwise, from the bodies of tuberculous cattle, by discovering that the milk of a tuberculous cow at the Experiment Station caused the mysterious disease when it was injected into guinea pigs that were afterwards permitted to live six weeks or longer. We collected milk from this cow repeatedly under the strictest conditions to exclude its infection from any source but the interior of her udder, and this milk proved to be fully as infectious as that collected earlier with less minutely elaborate precautions.

We again tried to isolate a specific microorganism, and as no growth appeared in the numerous tubes of culture media inoculated with small fragments of tissue from affected guinea pigs, we assumed that we were dealing with an organism that either could not be cultivated artificially or that would not grow in the culture media we had used; hence, as the disease was particularly severe in its action on the livers of guinea pigs, we concluded to try a culture medium to which bile had been added.

### ARTIFICIAL CULTIVATION OF THE BACILLUS.

On agar containing 6 per cent of glycerin and from 1 to 20 per cent of ox gall a growth was obtained which was more vigorous in the tubes to which 5 per cent or more of gall had been added than in those that contained less. Since obtaining this growth we have succeeded in cultivating the organism, which is a small bacterium, on other media, and have found that on some, on which it did not seem to grow at first, it multiplies quite well when the surface is smeared with pulp from the spleens of healthy guinea pigs.

We are not yet fully prepared to make a detailed statement about the different substances on which the germ will grow, especially as it multiplies better on several media after it has lived one or more generations under artificial conditions. Its appearance on the surface of glycerin-bile-agar is in the form of small, pearly, slightly convex, pale-gray colonies. The water of condensation in slanted tubes remains clear, but is covered with a very thin, broken, almost imperceptible layer that looks like a small amount of fine, white dust deposited on the surface of a fluid which does not wet it and into which it can not sink. A similar thin dustlike layer, beneath which the fluid remains perfectly clear, forms on the surface of some liquid media. This dustlike layer, when smear preparations of it are made and examined microscopically, has the appearance of a pure culture of the germ. In stab cultures the growth is located mainly at the surface, about the point of the puncture, giving the impression that multiplication, as with the tubercle bacillus, depends upon actual contact with air.

No growth has been obtained on any gelatin medium. On potato an almost imperceptible, flat, glistening layer with a very faint pink hue is formed. We are not certain that growth occurs in milk. Milk tubes inoculated directly from glycerin-bile-agar tubes and milk tubes inoculated from such milk tubes contain enough infection to cause the disease on injection into guinea pigs; but when the transfers from milk tube to milk tube are carried to the sixth generation the fluid seems to be innocuous and no germs are distinguishable microscopically in any of the milk tubes. On all media the growth is slow.

The temperature required for artificial cultivation is, as far as we have been able to determine, from 37° to 39° C., and the thermal death point of the bacterium is 60° C., maintained for 15 minutes.

## DESCRIPTION OF THE BACILLUS.

The germ, which has now been definitely identified as the *Bacillus abortus*, was at first believed by the writers to be Gram positive, but is now known to be Gram negative. It is a nonacid-fast bacillus, with rounded ends, about the size of a tubercle bacillus of the bovine type. On cover glasses from cultures, stained with Loeffler's methylene blue, the individual bacilli appear very minute and somewhat separated from each other; stained with Stirling's or anilin gentian-violet they appear to be larger and to lie closer together.

## INOCULATION TESTS.

We have repeatedly isolated this bacillus from the lesions in affected guinea pigs, have grown it in pure cultures, have caused the disease in other guinea pigs with the pure cultures, and have recovered pure cultures from the tissues of the latter. So far the guinea pig is the only animal species for which we have found it to be pathogenic, although we have injected it into rabbits, hogs, sheep, cats, dogs, chickens, and cattle. Its extremely slow and chronic action on guinea pigs, however, suggests that further inoculation tests with the other species of animals, if a sufficiently long period of time is permitted to pass, may give positive results.

## LESIONS CAUSED IN GUINEA PIGS.

Guinea pigs become infected either through the inoculation or the ingestion of pure cultures or of naturally infected milk, but show no well-marked lesions until after the passage of six weeks or more. The gross anatomical lesions are an extreme enlargement and edema of the lymph glands generally; the appearance of small glistening nodules in the lungs, which seem to be caused by the enlargement of minute lymph glands that are ordinarily too small to be visible; the conversion of the minute nodules in the lungs into larger, necrotic areas; an enormous enlargement of the spleen, often to thirty or forty times its normal volume; an irregular thickening of the capsule of the spleen, through which its surface becomes marked with white areas varying in size from mere points to several centimeters in diameter; an enlargement and degeneration of the liver, which organ becomes thickly beset on surface and section with irregular, pale yellow or dirty white areas that seem to be due to an enormous proliferation of connective tissue and a consequent crowding out and obliteration of the liver cells proper; a diffuse, parenchymatous nephritis that

reaches stages in which dense, fibrous nodules are formed in the cortex of the kidneys; and, in male guinea pigs, a degeneration of the testicles, commonly beginning in the epididymis and often resulting in the conversion of one or both testicles into structureless cysts filled with creamy pus. When the disease is due to subcutaneous inoculation of pure cultures, there are no local lesions or pathological conditions referable to the point at which the inoculation was made. The lesions produced by this bacillus are shown in Plates XXIII and XXIV, and for comparison the lesions caused by the tubercle bacillus are shown in Plate XXV.

In a small but not inconsiderable proportion of the infected guinea pigs a curious enlargement about some of the bone articulations occurs, through which the affected joint becomes stiff and useless. This condition is especially interesting from the bacteriological point of view, because, in the several cases in which careful examinations were made, it was found to be associated with a fairly large micrococcus, thus forecasting the possibility (as the condition has never occurred among the numerous other guinea pigs we have had under observation at the Experiment Station) of a microorganism that is harmless by itself but capable of doing serious injury in symbiosis with another microorganism. That this is not altogether a hypothetical view, but rather an inference drawn from experimental though as yet admittedly inadequate evidence, is shown by the occurrence of the joint disease in 1 of 6 guinea pigs, 2 of which were injected with a pure culture of the bacillus, 2 with a pure culture of the micrococcus, and 2 with mixed cultures of the bacillus and the micrococcus. It was 1 of the latter 2 that became affected with the joint disease. The 2 guinea pigs injected with pure culture of the micrococcus remained perfectly healthy, and the 4, of which 2 received pure culture of the bacillus and 2 mixed cultures of the two bacteria, in addition to the joint disease in 1, all developed the characteristic lesions the bacillus causes in guinea pigs.

## OCCURRENCE OF THE BACILLUS IN MILK.

Probably the most remarkable thing about the bacillus is its expulsion from the bodies of apparently healthy cows with their milk, and hence it is desirable to show that this is really a fact and not a supposition backed by doubtful evidence. First, the bacillus was repeatedly proved to occur in milk, collected with the utmost precautions against extraneous contamination, from a number of cows that had previously been found to be infected; and, second, its presence in the milk and in tissue from the udder and supramammary lymph gland of one cow was proved in the following manner:

Station cow No. 220, which had been known for some time through the injection of her milk into guinea pigs to be infected, was killed.

Immediately before her death her udder was carefully washed and disinfected and her teats closed with strong ligatures, and directly after her death her udder, including the supramammary lymph glands, was cut from her body. The skin was then dissected from the udder and the entire denuded surface thoroughly scorched with the flame of a large Bunsen burner; the flamed surface was next incised with a sterile knife and milk collected in sterile pipettes, through the incisions, separately from each quarter, at points well removed from the teats. With equal precautions fragments of tissue were taken from one front and one hind quarter of the udder, from the supramammary lymph gland, and from the liver and the spleen; and this material was inoculated subcutaneously into 15 guinea pigs, as follows:

One guinea pig, milk from right front quarter of udder; result positive.
One guinea pig, milk from right hind quarter of udder; result negative.
One guinea pig, milk from left front quarter of udder; result positive.
Two guinea pigs, milk from left hind quarter of udder; result negative.
Two guinea pigs, tissue from front quarter of udder; result positive.
Two guinea pigs, tissue from hind quarter of udder; result negative.
Two guinea pigs, tissue from supramammary lymph gland; result positive.
Two guinea pigs, tissue from spleen; result negative.
Two guinea pigs, tissue from liver; result negative.

The quantity of milk obtainable from the cow's udder, as she was nearly dry at the time of her death, was very small; otherwise two guinea pigs would have been inoculated with milk from each quarter.

It should be noted that the inoculations show positive results with both the milk and the tissue from the front quarters of the udder and negative results with both the milk and the tissue from the hind quarters, and that strength is added to the evidence which proves that the germ was located in the depths of the udder by the positive results obtained with the inoculation of tissue from the supramammary lymph gland.

The post-mortem examination of the cow revealed nothing to explain the persistent occurrence of the bacillus in her milk, excepting a few small areas of slight induration in her udder. A second cow that also expelled the bacillus with her milk has been killed, examined post-mortem, and material obtained from her body for guinea-pig injections. The autopsy showed no other lesions than were found in the first cow, and it is too early to report on the guinea pigs. It may be well to add that the blood and urine of several cows from which infected milk was obtained were tested by inoculating guinea pigs, and invariably failed to cause disease.

Some studies relative to the way in which the udders of cows become infected have been made. Several cows were selected and proved by repeated injections of their milk into the abdominal cavities of guinea pigs to be free from the infection. On the udder

and teats of one cow pure cultures of the bacillus were rubbed; another cow was fed pure cultures in her drinking water, and a third was given subcutaneous injections of pure cultures. This work is not yet complete, but as far as it has gone it has given negative results.

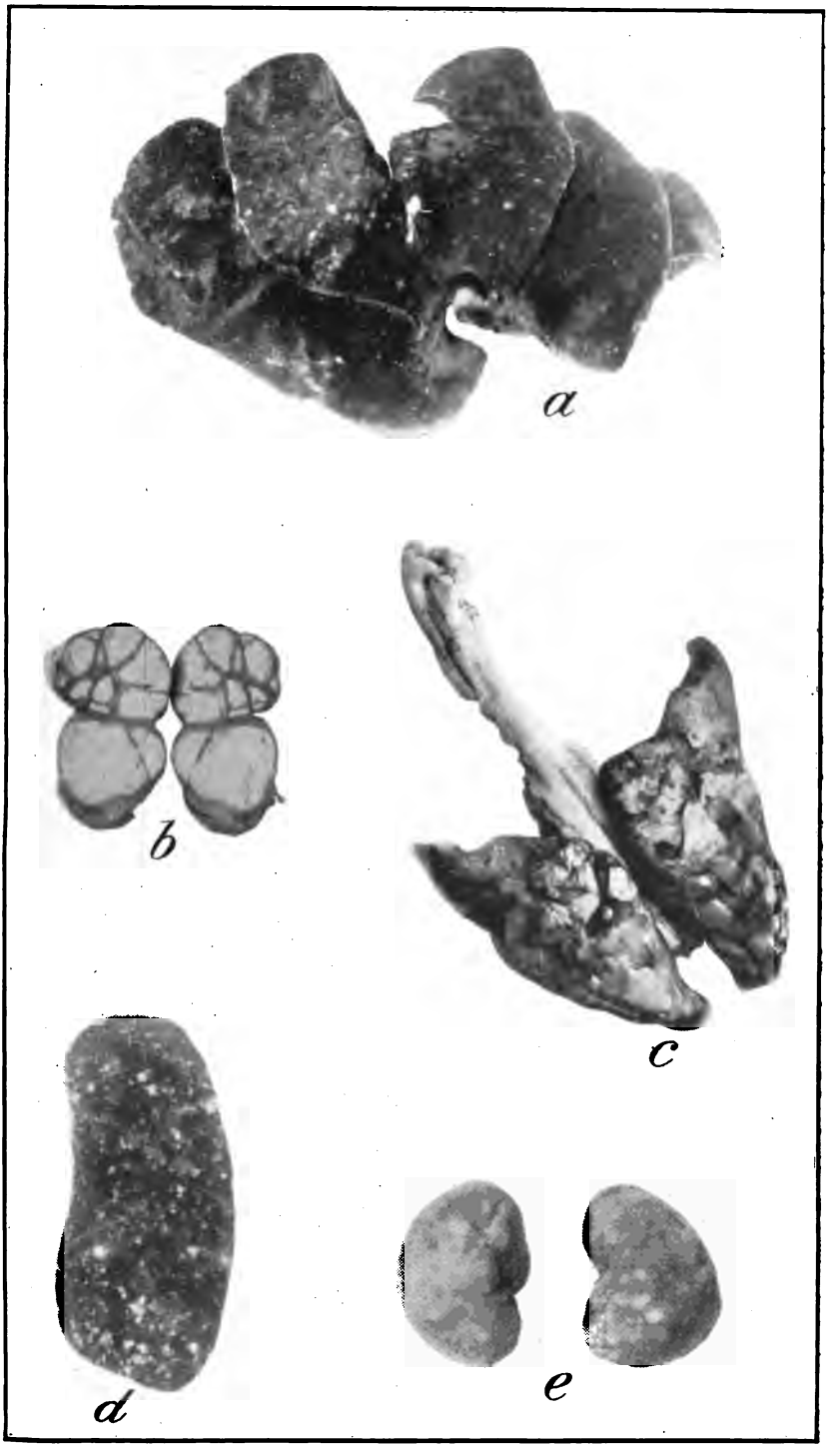
The frequency with which we found the bacillus to occur in ordinary market milk is illustrated by the samples examined since we first observed the curious disease in guinea pigs. In one series we tested 77 samples of milk from 31 dairies, and 8 of the samples derived from 6 different dairies were found to be infected. In another series we tested 140 samples from 4 dairies, with the following results: Dairy A, 35 samples, 11 infected; dairy B, 33 samples, 7 infected; dairy C, 34 samples, 2 infected; dairy D, 38 samples, 2 infected. The 77 samples in the first series of tests, with the 140 in the second, make a total of 217, among which 30, or nearly 14 per cent, proved to contain the bacillus. As dairies A, B, C, and D are among the 31 from which the 77 samples of the first series of tests were obtained, and are 4 of the 6 infected, the proportion of infected dairies is not changed by the second series of tests.

In addition to the samples of market milk we have tested one sample each of the milk from 140 dairy cows that constitute a single large herd in the District of Columbia, and from 36 cows that belonged to the Experiment Station at Bethesda, Md. Among the 140 cows the bacillus was found in the milk of 19, and among the 36 cows it was being passed by 11. The 140 cows form a herd that has been repeatedly tested with tuberculin and is very probably free from tuberculosis. A large proportion of the 36 station cows were affected with advanced tuberculosis, and among the 11 that were found to be passing the bacillus 8 were advanced cases of tuberculosis, 1 was affected with actinomycosis, and 2 were apparently healthy.

One of the tuberculous cows at the station that was passing the bacillus was affected with tuberculous disease of her udder. Her milk caused both tuberculosis and the other disease in the guinea pigs injected with it, showing that the two diseases can live in harmony in one animal body; in fact, each seemed to increase the pernicious potency of the other. (See Pl. XXVI.) Guinea pigs with the double infection formed interesting subjects, because the tubercle bacillus in the lesions could easily be demonstrated in stained preparations, while the other bacillus, which was microscopically invisible to us, could be cultivated on media that is unsuitable for the tubercle bacillus.

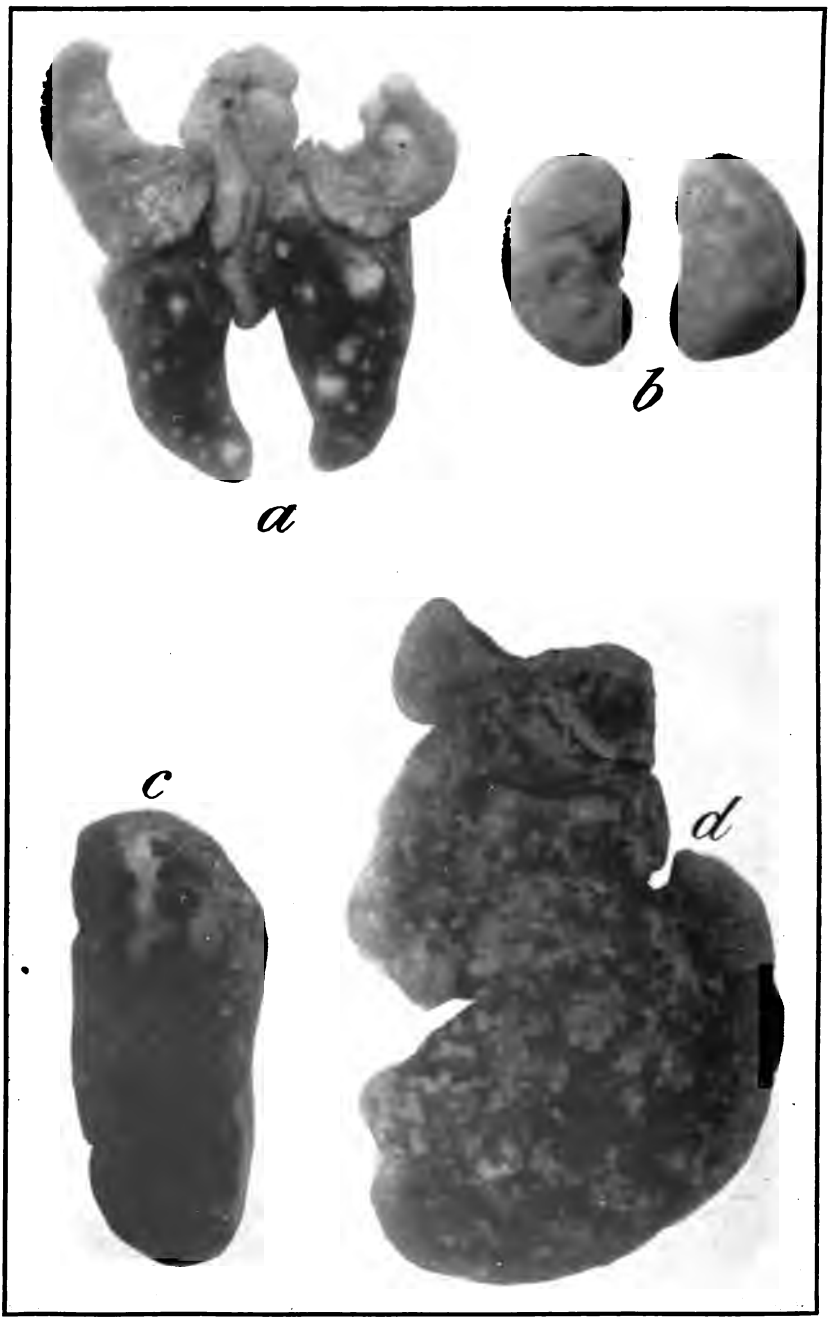
## CONCLUSION.

What the real significance or practical importance of this bacillus, the presence of which in milk appears to have escaped detection in the past very likely because of the difficulties associated with



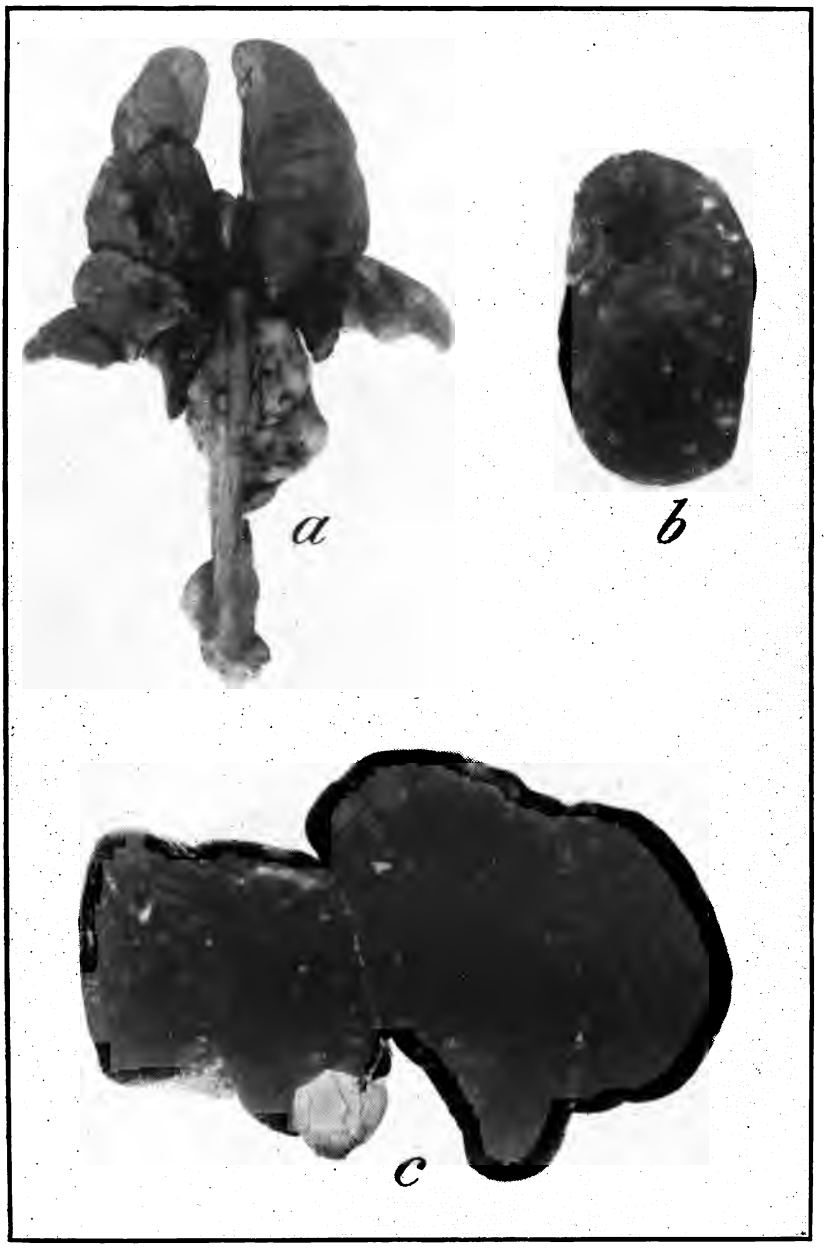

ORGANS OF GUINEA PIG, SHOWING LESIONS CAUSED BY ABORTION BACILLUS.

*a*, Liver; *b*, testicles; *c*, lungs; *d*, spleen; *e*, kidneys. The white spots in the kidneys are fibrous nodules in the degenerated cortex. The testicles are necrotic throughout, excepting the dark lines, which are bands of connective tissue.




ORGANS OF GUINEA PIG, SHOWING LESIONS CAUSED BY ABORTION BACILLUS.

*a*, Lungs; *b*, kidneys; *c*, spleen; *d*, liver. The white spots in the lungs are an advanced stage of a condition which first manifests itself in the form of very minute, glistening, almost transparent nodules, which gradually increase in size, develop gray centers, and finally become comparatively large necrotic areas.




ORGANS OF GUINEA PIG, SHOWING LESIONS CAUSED BY TUBERCLE BACILLUS.

*a*, Lungs; *b*, spleen; *c*, liver. A comparison of this plate with Plates XXIII and XXIV will show the remarkable similarity in the macroscopic appearance of the lesions caused in guinea pigs by the abortion bacillus and by the tubercle bacillus.

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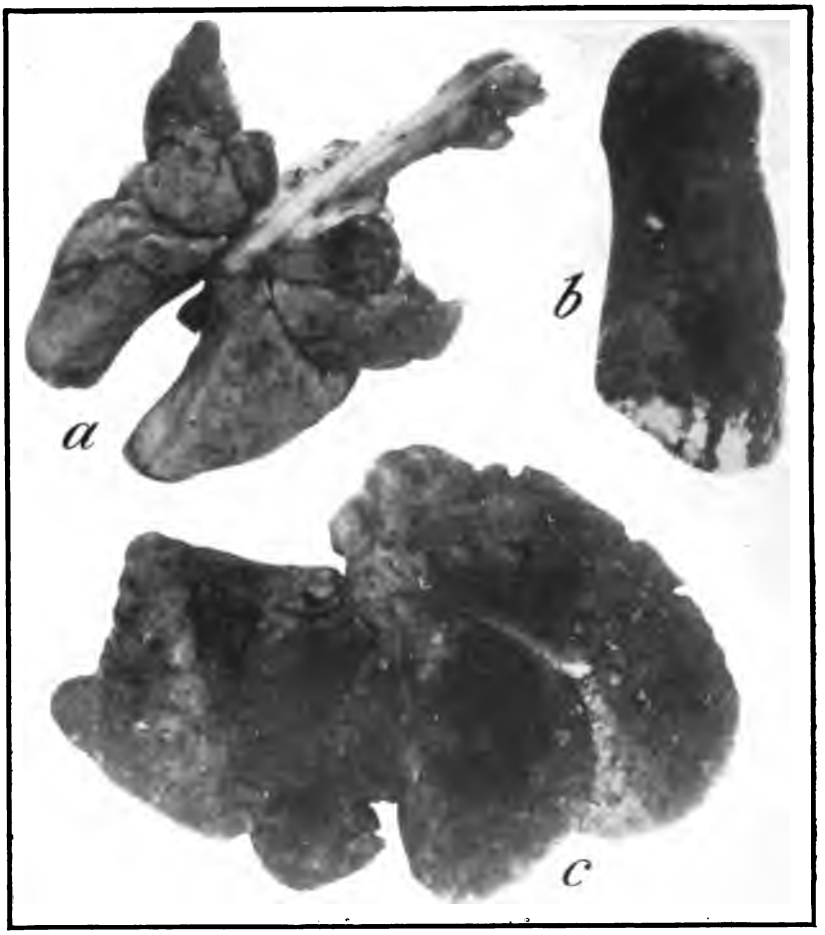


FIG. 1.—ORGANS OF GUINEA PIG, SHOWING LESIONS CAUSED BY ABORTION BACILLUS IN COMBINATION WITH TUBERCLE BACILLUS.

*a*, Lungs; *b*, spleen; *c*, liver. Each bacillus seems to increase the pathogenic potency of the other for guinea pigs.

FIG. 2.—SPLEEN OF GUINEA PIG AFFECTED WITH TUBERCULOSIS IN COMBINATION WITH DISEASE CAUSED BY ABORTION BACILLUS.

Weight of spleen, 31 grams. The normal weight of a guinea-pig spleen is less than 1 gram. The organ weighed more than 40 times as much as a normal spleen, its enormous size being due to the abortion bacillus.

its artificial cultivation and the length of time it requires to cause well-marked lesions in guinea pigs, may ultimately prove to be we are unable to say. But no one can doubt that the common occurrence of a microorganism, pathogenic for any species of animal, in an article of food as widely and as extensively used as milk, deserves that we should study it with the greatest care, especially after it has been shown that it is an organism which has the udders of apparently healthy cows as its normal habitat, and which therefore can not be certainly excluded from milk, no matter how much cleanliness and care are used in its production. In this sense the germ forms another link in the long chain of facts that point unmistakably to the proper pasteurization of all milk before it is used as food as a measure essentially necessary for the protection of public health.

## ADDENDA.

The data available at the Experiment Station of the bureau show conclusively that the bacillus with which the foregoing paper deals, and which is now known to be the bacillus of contagious abortion of cattle, may be eliminated continuously for years in the milk of infected cows that no longer abort. The following history of two cows illustrates this remarkable fact:

*Cow 657.*

June 15, 1908, received at the Experiment Station, age about 5 years.
October 15, 1908, gave birth to a healthy female calf.
February 29, 1909, test of milk proved that it contained the bacillus now known to be the germ of infectious abortion.
May 18, 1909, bacillus proved to be in milk.
May 24, 1909, bacillus proved to be in milk.
September 14, 1909, gave birth to a healthy female calf.
October 14, 1909, bacillus proved to be present in milk from all four quarters of udder.
February 14, 1910, milk tested and proved to be infected.
September 22, 1910, milk tested and proved to be infected.
November 3, 1910, milk tested and proved to be infected.
November 18, 1910, milk tested and proved to be infected.
November 23, 1910, milk tested and proved to be infected.
July 26, 1911, aborted, 5 months fetus. Tests proved the bacillus to be present in the abdominal fluid, liver, and spleen of the fetus.
July 31, 1911, milk tested and proved to be infected.
September 22, 1911, milk tested and proved to be infected.
October 2, 1911, butter made from milk of this cow found to be infected.
October 9, 1911, milk tested and proved to be infected.
December 4, 1911, milk tested and proved to be infected.

Later tests have been made, but the guinea pigs inoculated with the milk of the cow have not yet been autopsied.

The record shows that the bacillus was present in the milk of the cow from February 29, 1909, to December 4, 1911, or a period of

about two years and nine months. There is no reason now, after three years, to believe that it has disappeared from the milk. Whether this cow ever aborted before she was received at the station is not known. It is remarkable that she produced a healthy calf about six and one-half months after the abortion bacillus was found in her milk, and then aborted at her next pregnancy, two years and five months after her milk was known to be infected. The milk caused the peculiar tuberculosislike lesions in guinea pigs both through inoculation and ingestion.

*Cow No. 642.*

June 15, 1908, received at the Experiment Station, about 6 years old.
June 20, 1908, aborted; precise age of fetus not known. The abortion was attributed to something incident to transportation from place of former owner to the station.
December 18, 1909, gave birth to a healthy male calf.
October 24, 1910, aborted, 7 months fetus. Tests of fetus showed the presence of the bacillus.
November 21, 1910, milk tested and proved to be infected.
December 1, 1910, milk tested and proved to be infected.
May 22, 1910, milk tested and proved to be infected.
February 23, 1911, milk tested and proved to be infected.
September 11, 1911, milk tested and proved to be infected.
October 9, 1911, gave birth to a healthy female calf.

The record shows that the milk was infected from October 24, 1910, to September 11, 1911. Later tests will probably show that the milk is still infected.

# III.—INFECTIOUS ABORTION OF CATTLE.

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AND
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## INTRODUCTION.

In reviewing the field of veterinary research covered during the year 1911 the particular event which indicates marked progress in the study of animal diseases is the work on infectious abortion that is being conducted in this and other countries.

From the viewpoint of economic importance, infectious abortion of cattle ranks second only to tuberculosis, and in certain sections of the country even supersedes the latter in the monetary loss it occasions. Aside from the loss of the calf, the loss occasioned by the reduction in milk supply, together with the failure to conceive for several months or forever after the abortion, and the frequency of retained placenta, has made this disease the bane of dairymen and stock raisers.

The exact financial loss can not be even approximately estimated, but from the fact that the disease exists in all sections of the country, both in dairy and range cattle, as is evidenced by the reports from various State officials, and from the inquiries received at this bureau regarding this disease, it can safely be stated that the direct loss reaches into the millions, while the potential loss is likewise enormous and inestimable. Thus in the last two years the Pathological Division of this bureau received correspondence from 32 different States regarding treatment, prevention, and eradication of the disease. Furthermore, the disease is of such an insidious character that it may be brought into a herd by an unsuspected animal without attracting attention, inasmuch as there are no readily noted symptoms present in the diseased animal.

In this publication we will concern ourselves only with the type of abortion as found in enzootic or epizootic form among cattle. We will not include the premature delivery of the fetus caused by mechanical injuries, frozen, moldy, or smutty feed, or by other causes of a noninfectious character, nor will we refer to those infectious diseases affecting the mother during the course of which the fetus is expelled from the uterus prior to the completion of the full period

of gestation. Instead we will limit ourselves to that form of abortion in which there is practically no apparent change in the health of the mother prior to the abortion.

## DEFINITION.

Infectious abortion of cattle is a specific infectious disease produced by the *Bacillus abortus* of Bang and characterized by inflammatory changes of the mucous membrane of the uterus and fetal membranes, resulting as a rule in the premature expulsion of the fetus.

Synonyms: Contagious abortion; epizootic abortion; enzootic abortion; slinking of calves.

## HISTORY.

This disease has been known in England and Continental Europe for many years, and descriptions of it are mentioned in the writings of Mascal, Lafoose, Skellet, Lawrence, St. Cyr, Zündel, and Youatt. In the early part of the eighteenth century British veterinarians recognized its contagiousness, but it remained for Franck (1876), Lehnert (1878), and Bräuer (1880) to produce the disease in healthy pregnant cows by the introduction of exudate and material from aborting animals. Nocard (1888) isolated from the exudate between the mucous membrane of the uterus and fetal membranes a micrococcus and a short bacillus which were found continually in contagious abortion, but he failed to reproduce the disease by inoculations of pure cultures of these organisms into healthy pregnant animals. In 1897 Bang,[a 1] assisted by Stribolt, published their findings regarding infectious abortion of cattle, in which they incriminated as the causative agent Bang's bacillus of abortion. With pure cultures of this bacillus they were able to produce the disease artificially and to recover the same organism from the experimental cases.

Preisz,[21] Nowak,[20] Zwick,[28] Holth,[10] McFadyean and Stockman,[15] MacNeal and Kerr,[14] Good,[7] Giltner,[6] and others have corroborated these findings, especially with reference to the causative agent. Grinsted,[8] Wall,[24] Holth,[9] Brüll,[4] Larson,[12] and other workers have more recently concerned themselves principally with the diagnosis of the disease.

## CAUSE.

Bang and Stribolt obtained in pure culture a short, nonmotile, Gram negative, pleomorphic rod from the exudate found between the mucous membrane of the uterus and the fetal membranes of a cow which was killed while showing the symptoms of approaching abortion. These investigators proved that the organism was the

[a] Superior numerals refer to bibliography at end of paper.

specific cause of abortion by injecting pure cultures of this bacterium into the vaginas of two cows and producing abortion in one after a little over two months. The other cow was killed while showing premonitory symptoms of the disease. In both instances they recovered the *Bacillus abortus* from the exudate of the uterus. These investigators were also successful in producing abortion in pregnant cows by intravenous injection and the feeding of pure cultures of the organism, and in every instance recovered the organism from the experiment animals. Their findings have since been substantiated by many European observers and particularly by McFadyean and Stockman, of England.

In this country Moore [19] and Law, in New York, and Chester, in Delaware, incriminated a variety of the colon bacillus as the causative agent. MacNeal and Kerr [14] were the first American workers, however, to record the isolation and cultivation of Bang's bacillus of abortion from the placentas of two clinical cases of infectious abortion. These workers used the Nowak plate method for obtaining this organism in pure culture. They also succeeded in growing the organism on the slanted surface of serum agar by inoculations from plate colonies, but only in the presence of the *Bacillus subtilis*. There is no doubt that the *Bacillus abortus* has been observed by several American workers during the past decade, but in view of the fact that the organism found by them could not satisfy the specific biological requirements as set forth by Bang, and especially so with reference to the oxygen optima, confirmatory results were not published. Thus it was the accepted opinion that colonies develop only in a zone about a centimeter from the surface of a shake culture, extending to 2 to 2½ centimeters from the surface, Bang claiming that this organism was neither aerobic nor anaerobic. He also asserted that the oxygen optima was, first, a degree of oxygen tension in nutritive medium less than that of atmospheric air, and, second, the presence in the nutritive medium of a very high oxygen tension, which, however, lies somewhat under 100 per cent. He claimed that between these two optima there is an intermediate zone in which the abortion bacillus grows badly or not at all.

The English commission [15] found that an organism isolated from the uterine exudate of a typical case of infectious abortion would grow readily in the presence of air, and in several instances the growth appeared on the surface of the water of condensation before it did in the subsurface. In view of Bang's biologic requirements they at times doubted that they were dealing with Bang's bacillus of abortion, and in several instances resorted to inoculations and comparisons with cultures obtained from Bang, with the result that the identity of the organisms was proved conclusively.

In the Pathological Division of the Bureau of Animal Industry it was found by the writers that the organisms, obtained from the stomach of an aborted fetus and grown according to Bang in agar-gelatin horse-serum shake cultures, would appear as small bluish-green colonies on the side of the tube in the presence of air, and with several reinoculations on slant agar, with or without glycerin, luxuriant growths could be obtained. The growth on the slant agar is as a rule rather slow at first, but after several generations under aerobic conditions an excellent growth can be obtained within 1 to 3 days.

The organisms isolated by us agree in morphology, cultural characteristics, and staining properties with those described by the Danish, English, and other observers, and pure cultures of the bacillus are capable of producing abortion in pregnant animals, from the tissues of which the organism may be readily recovered. Even with these requirements satisfied it has been the practice in this laboratory to make both an agglutinating fluid and an antigen with these organisms and test them with a known serum before identifying them as abortion bacilli.

## DESCRIPTION AND CHARACTERISTICS OF THE CAUSATIVE ORGANISM.

### MORPHOLOGY.

*Bacillus abortus* is a short, nonmotile, pleomorphic rod, most often of a coccoid form, 0.4 to 0.6 μ wide by 1 to 2 μ long; frequently its length will be less than 1 μ or as long as 3 μ. A smear from the exudate or gastro-intestinal contents of the fetus will show the bacilli in masses composed of short coccoid or longer forms. Cultures, especially young ones, as Holth describes, show more regularity and usually are of distinct bacillary form. Involution forms of various shapes are observed in smears from older cultures. (Pl. XXVII.)

### STAINING.

Ordinary anilin dyes stain the organism satisfactorily. In some smears the bacilli do not take the stain as readily as in others. Carbol fuchsin followed by 1 per cent acetic acid and also Loeffler's methylene blue bring out the pleomorphism of this organism to advantage. Unstained areas will be seen in the center, giving the bacillus the appearance of a polar or peripheral stained organism. Other bacilli will show clear or lighter areas on the sides or at the poles. The more intense staining reagents, as thionin, carbol fuchsin, gentian, or methyl violet, will stain the organism uniformly. Dilute carbol fuchsin, recommended by the English commission, gives very desirable results. In sections of tissues methyl green pyronin has given

fairly satisfactory results. With the Gram method of staining negative results are always obtained. In a few instances, however, the organism may retain a very slight amount of stain as compared with Gram positive organisms used as controls on the same slide. (Pl. XXVII.)

CULTURAL CHARACTERISTICS.

Relative to culture media, it was found that the agar gelatin raw-serum shake of Bang and the autoclaved alkalinized agar gelatin serum of the English commission both gave satisfactory results in obtaining cultures from the uterine or fetal material in a good state of preservation. Still more satisfactory was an agar gelatin serum mixture, the serum in this case being heated in Arnold's sterilizer at 60° C. for one hour each day for four consecutive days, which insured sterility. The last two methods are the most convenient and less apt to give contamination. The Nowak method of plating in the presence of a culture of *Bacillus subtilis* was only occasionally used. For the propagation of cultures ordinary slant or stab agar, with or without glycerin and glycerin bouillon, or serum glycerin bouillon are used. Holth and the English commission also recommended a liver bouillon culture as a suitable medium for the growth of the organism.

The writers have made extensive use of a gelatin agar shake, with or without bouillon, for the isolation of the organism. The media are composed of gelatin 40 parts and agar 60 parts, or gelatin 40 parts, bouillon 10 parts, and agar 50 parts. (Pl. XXVIII, fig. 2.)

*Bouillon.*—The inoculation of 3 per cent glycerin bouillon causes the liquid to become slightly cloudy after several days' growth and in many instances a very fine granular film is observed on the surface. Turbidity increases, but after several weeks the growth settles and the medium becomes clear. A sediment is noticed in a few days after inoculation, especially when sown heavily. This sediment as a rule becomes stringy, but in some cultures this is not so marked. Cultures in bouillon or serum bouillon often leave a bluish line or ring on the tube at the point where the surface of the culture comes in contact with the side of the tube. The reaction is neutral to litmus. Nowak considers bouillon a very suitable medium for the growth of this organism. The English workers claim that the addition of 1 per cent grape sugar makes the growth more luxuriant.

*Slant agar (with or without glycerin).*—In cultures sown from subsurface colonies or from tissues, evidences of growth are not observed for at least 7 days, usually 10 to 12 days, at which time a watery film appears which is soon transformed into a grayish glistening growth in direct light and light bluish-green in transmitted

PLATE XXVII.—BACILLUS ABORTUS FROM CATTLE.

FIG. 1.—Cover-glass preparation from an 8-days-old culture; stained with dilute carbol-fuchsin.

FIG. 2.—Cover-glass preparation from an 8-days-old culture; stained by Gram's method and counterstained with dilute carbol-fuchsin. On the same film are avian tubercle bacilli used as a control, which are seen to retain the Gram stain.

FIG. 3.—A 4-months-old culture showing involution forms; stained with dilute fuchsin.

These camera lucida drawings were reproduced at the level of the stand with Zeiss No. 4 compensating ocular and 2 mm. oil immersion objective.

PLATE XXVIII.—CULTURES OF BACILLUS ABORTUS.

FIG. 1.—An 8-days-old culture on 3 per cent glycerin-agar; originally obtained from the stomach contents of an aborted fetus.

FIG. 2.—A 10-days-old gelatin agar shake culture from the vaginal discharge following abortion.

FIG. 3.—A 3-weeks-old potato culture of *Bacillus abortus*, showing the similarity in growth to *B. mallei*.

PLATE XXIX.—COLONIES OF BACILLUS ABORTUS ON PLATE AGAR.

FIG. 1.—The two large colonies are surface growths of *Bacillus abortus;* the others are submerged colonies. All colonies in this figure are magnified 20 times.

FIG. 2.—Agar plate 10 days old, showing growths of *B. abortus* as small colonies. The large colonies and spreading growths are contaminating organisms.

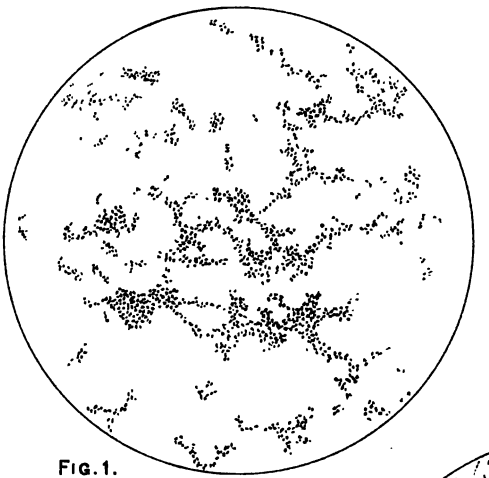

FIG. 1.

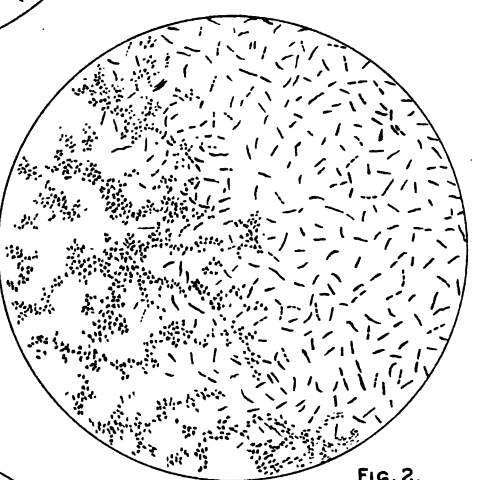

FIG. 2.

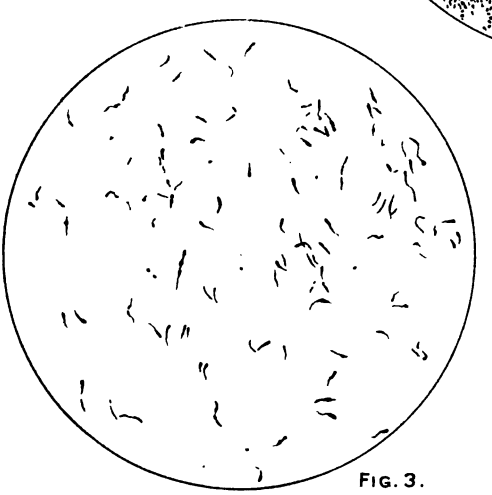

FIG. 3.

BACILLUS ABORTUS FROM CATTLE.

Haines, del.

BRUNER & KESSLER CO PHILA

FIG. 1.

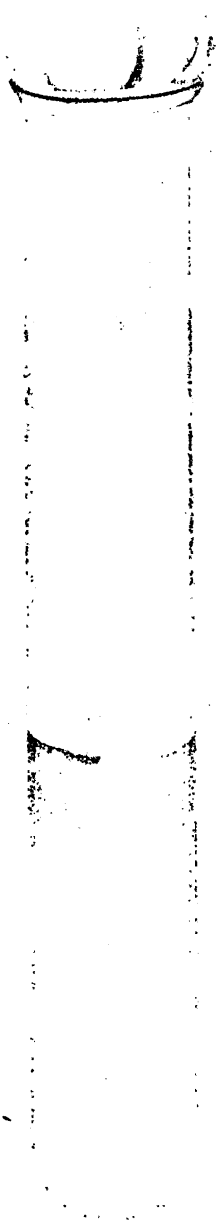

FIG. 2.

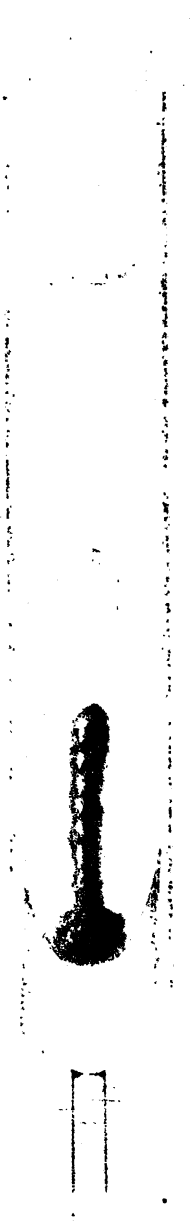

FIG. 3.

CULTURES OF BACILLUS ABORTUS.

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FIG. 1.

FIG. 2.

COLONIES OF BACILLUS ABORTUS ON PLATE AGAR.

(Large colonies and spreading growths in lower figure are contaminating organisms.)

Haines, del.

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UNIV. OF MICH.

light. The cultures soon take on a yellowish-brown appearance, beginning at the center and becoming darker with age. In thinly seeded cultures there appear small glistening, round, raised colonies showing a grayish center and a bluish-green edge, which have very little tendency to spread. They vary in size from a pin point to 4½ millimeters. The individual colonies soon show a yellowish-brown center, the entire growth becoming darker in appearance, similar to that described above for the diffused colonies. (Pl. XXVIII, fig. 1.) The water of condensation shows a grayish sediment and a fine granular film on the surface which is easily disturbed. Growth on this medium is often very glutinous. Cultures made from aerobic growths and especially from slant agar show a luxuriant growth in 2 to 3 days. Individual colonies on agar plates present the same appearances as those described on slant agar. (Pl. XXIX.)

*Stab agar.*—Cultures on this medium show sacculatelike growths developing along the line of inoculation within 2 or 3 days. The growth on the surface, which is more profuse, appears at first glistening grayish white, later it becomes dirty gray, and finally brownish-yellow in color.

*Gelatin* at room temperature does not appear to be a very good medium for the growth of this organism. On several occasions, however, we succeeded in growing *Bacillus abortus* in this medium. The medium was not liquefied; growth was very slow.

*Potato.*—This culture medium has given variable results. It must be stated, however, that ofttimes the organism grows well on potato. It shows a glistening honeylike growth resembling somewhat the appearance of *Bacillus mallei.* (Pl. XXVII, fig. 3.) This similarity has been observed by most workers.

*Milk.*—While the organisms multiply in this medium, no perceptible change is noticed as a result of such multiplication. The reaction is neutral or slightly acid.

*Fermentation tubes.*—No gas is produced in dextrose, saccharose, or lactose. The reaction after several days is either neutral or alkaline to litmus. The growth is most prominent in the neck of the tube, the bulb later becoming cloudy; the closed arm, however, in all instances remained clear, even if organisms were shaken into it.

*Tenacity.*—Three-day-old agar slant cultures in test tubes washed with 0.85 per cent salt solution and heated to 55 to 56° C. in a water bath for three-fourths of an hour were not killed; exposure to the same temperature for one hour, however, resulted in the death of the bacilli.

Cultures grown like the above, but poured together in a liter flask and subjected to a temperature of 55 to 56° C., were not destroyed at the end of an hour, but were killed in 1½ hours. A bouillon culture heated to 70° C. for 7½ minutes failed to grow when reinocu-

lated. A temperature of 60° C. killed in 15 minutes cultures grown on slant agar and washed with sterile salt solution.

Bang found viable organisms in a uterine exudate kept in an ice chest for 7 months. Nowak reports that he obtained subcultures from a year-old culture.

Holth obtained a culture from material from fetuses kept at 2 to 4° C. for 8 months, and also from a series of pure cultures kept at room temperature for 9 months, but no growth could be obtained at the end of 1 year.

The writers have found this quality of the organism a variable one. Cultures on agar slants with paraffined plugs, kept at room temperature, have remained alive for 6 months. Cultures kept under the same condition for 9 months were no longer viable. The same observations were obtained with cultures stored in the ice chest for a similar length of time. Bouillon cultures kept at room temperature were still viable after 8 months.

## BACTERIAL FLORA OF THE VAGINA.

Preliminary to our investigation of abortion a study was made of the bacterial flora of the bovine vagina in order to ascertain the character and frequency of the organisms present. The vaginas of nine animals were examined, six while alive and three after they had been slaughtered for beef, all the cows coming from a herd known to be free from infectious abortion. In all instances the search for *Bacillus abortus* gave negative results. Among the most frequently observed species which have been definitely determined are *Bacillus coli*, *Bacillus subtilis*, *Streptococcus pyogenes albus*, *Streptococcus pyogenes bovis*, *Pseudomonas pyocyanea*, *Bacillus mesentericus*, *Bacillus vulgaris*, *Cladothrix nonliquefaciens*, and *Sarcina subflava*.

The number of undetermined species is much larger and includes the following: A nonmotile, sporeless, liquefying bacterium occurring in chains of 6 or more cells, and frequently single, 2 to 3.5 μ long and 0.8 μ wide; a motile, spore-bearing, nonliquefying bacillus, 1.8 μ long and 0.6 μ wide; a Gram positive diplococcus about 1.2 μ in diameter, with slight ability to liquefy gelatin, but capable of producing dark red pigment on various culture media; a nonmotile bacterium varying in length from 2 to 6 μ and in width from 0.8 to 1.5 μ, with many involution forms; a Gram negative, nonchromogenic diplococcus about 1 μ in diameter, capable of liquefying gelatin and coagulating milk; a spore-bearing, liquefying bacillus, with rounded ends, occurring in pairs of short chains of 3 or 4 elements without the coagulation of milk; a nonmotile, nonspore-bearing, liquefying bacterium 2 to 3 μ long and 1 μ broad; an aerobic, motile, liquefying bacillus, with rounded ends, resembling in appearance and size the

*Bacillus suisepticus;* an aerobic, liquefying staphylococcus which failed to produce pigment on any culture medium; and several other organisms which have not as yet been studied.

While there was a certain uniformity in the species revealed, there were many types of organisms present that were probably transient and the result of contamination through the vulva. All of these different organisms were not present in every case, and in many instances the species mentioned was found only in individual cases.

## INFECTIVENESS.

That the *Bacillus abortus* of Bang is capable of producing abortion experimentally in cattle, sheep, swine, goats, mares, guinea pigs, and rabbits by feeding and by intravenous injections has been satisfactorily proven by Bang, Nowak, McFadyean and Stockman, MacNeal and Kerr, Good, and others.[3]

Of the other pathological changes produced by this organism, MacNeal and Kerr mention that in one of their guinea pigs inoculated subcutaneously, there appeared at the point of inoculation a purulent inflammation. Holth was able to kill white mice and spotted rats in two and three days, respectively, by intraperitoneal inoculation of ¼ c. c. of a serum bouillon culture, and found the organism in the blood. Such was not our experience until quite recently, when a very virulent strain of the organism was isolated which killed mice in 48 hours. With all other strains white mice inoculated intraperitoneally failed to die. We were, however, successful in producing an enlarged nodular spleen in these animals at the end of 2½ to 3 months. Spotted rats were not used, but white rats failed to show any ill effects at the end of 2 months from such inoculation.

In two pregnant guinea pigs inoculated subcutaneously by the writers with 1 and 2 c. c., respectively, of a 7-day-old bouillon culture, both of which aborted 10 days after injection, a considerable tumefaction appeared at the point of inoculation. This is not an infrequent occurrence in guinea pigs inoculated subcutaneously. One of these guinea pigs when chloroformed 2 months after inoculation still showed a small, bean-size, soft, caseated mass, with the surrounding tissue of a brownish-yellow color. From this caseated mass pure cultures of the *Bacillus abortus* were obtained direct on slant agar, and in shake cultures there appeared at the same time subsurface and surface growths. The uterus of this guinea pig was inflamed and contained a brownish-yellow viscid material from which *B. abortus* alone was isolated.

Smith and Fabyan,[28] working with necrotic cotyledons from an aborting cow, and suspecting the possibility of tuberculosis, inoculated a portion of their material into a guinea pig. Several months

after the inoculation they chloroformed the animal, and to their surprise found an engorged spleen, enlargements of subcutaneous and visceral lymph nodes, and infiltration and yellowish nodules of the liver. Inoculation with organs from this animal and inoculations with cultures of *Bacillus abortus* from several sources gave these authors similar lesions, with the addition that some guinea pigs so inoculated showed lesions in the lungs, testes, ribs, and eyes.

Various workers in the laboratories of the Bureau of Animal Industry, including Theobald Smith, have for many years observed that guinea pigs inoculated with milk for the purpose of detecting or isolating the tubercle bacillus, and autopsied at the end of 2½ or more months, showed lesions resembling to some extent those of tuberculosis, but in which no tubercle bacilli could be demonstrated. It remained, however, for Schroeder and Cotton,[22] of this bureau, to isolate and describe the organism that was responsible for these lesions. At the same time the present writers were working on various phases of contagious abortion in cattle, and had just succeeded in growing *B. abortus* on slant agar. The similarity of the Schroeder and Cotton organism, known to them as bacillus 637, and the *B. abortus* was so marked in both morphology and cultural characteristics as to lead the writers to suspect that these two organisms were identical, and this suspicion was strengthened by the fact that Schroeder and Cotton had obtained a good portion of their milk from which they isolated their organism by guinea pig inoculations from the same institution from which the writers were receiving a great deal of the material for their work on contagious abortion. The writers at once inoculated guinea pigs with pure cultures of *B. abortus*, with the result that similar lesions were produced. The reaction to the Gram method of staining still kept these two organisms apart, since Schroeder and Cotton described their bacillus 637 as Gram positive, while *B. abortus* has given the writers and other workers negative results by this method. Cultures were then exchanged, with the result that both bacillus 637 and *B. abortus* failed to take the stain with the Gram method. The organism isolated from milk was compared with the *B. abortus* from several laboratories, and no difference could be detected in either cultural characteristics or morphology; and finally the use of bacillus 637 as an antigen in applying the complement-fixation test to sera from naturally and experimentally infected animals with *B. abortus* established the identity of these organisms beyond a doubt.[16] The fact that the organism can produce characteristic lesions in guinea pigs makes the isolation of the *B. abortus* even from contaminated material a relatively simple matter.

Probably the most important and comprehensive facts which have been demonstrated in connection with this disease are the discovery

that the abortion bacillus is eliminated with the milk of infected cows, and, secondly, that this bacillus is found in the tonsils of children, presumably as the result of drinking such infected milk. The frequency of the presence of *B. abortus* in a food product like milk and the ability of the organisms to produce lesions in guinea pigs, pregnant cows, and other animals led at once to the thought that *B. abortus* might prove pathogenic for human beings. As a result our endeavors were directed along three lines: First, to obtain sera promiscuously from human beings, and in case of positive reactions to learn more about the person whose serum showed the reaction; second, to obtain samples of milk from women in order to examine it for this bacillus; and, third, to obtain tonsils from milk-consuming children at the various children's hospitals and inoculate such material into guinea pigs. Material for these lines of work was not forthcoming as fast as desired. Out of 42 sera from human beings no positive results were obtained by either the complement-fixation or agglutination tests, although in similar tests made by Larson 3 out of 100 specimens of sera gave positive results. No samples of human milk have thus far been obtained. Out of 56 tonsils and adenoids inoculated into guinea pigs, tonsil No. 3 produced nodular areas in the liver, but cultures from this organ remain sterile. Tonsils from case No. 8 inoculated into 2 guinea pigs showed in one of them after 3 months distinct lesions of infection in the liver, spleen, and testicles, and *B. abortus* was obtained from the lesions.

That the virulence of the different strains varies has been our constant experience; in fact, within two or three generations the same strain seems to vary considerably. Of 4 pregnant rabbits inoculated with a strain of *B. abortus*, 1 intravenously and 1 subcutaneously injected rabbit aborted in 13 and 17 days, respectively, after the inoculations. One rabbit that received intravenous inoculation was apparently not pregnant or else aborted and did away with the fetuses. The fourth gave birth to a litter of young ones 30 days after inoculation. The same experiment was repeated with the same strain after two generations of subsequent growth on artificial media, but with negative results. The difference noted above between Holth's white-mice inoculations and our earlier experience with white mice may also be explained by the difference in virulence and probably also the difference of resistance of the inoculated animals. Dogs, cats, and chickens fed and inoculated with this organism failed to show any evidence of infection.

That the *Bacillus abortus* might possibly play a part in the production of disease of newly born calves, especially white scours and septicemia, is suggested by the fact that these diseases are often found coexisting with infectious abortion in a herd. Jensen [11] found 1 out of 208 cases of white scours directly traceable to the abortion

bacillus. Holth was unable to obtain either a complement-fixation or agglutination reaction from calves that died of diarrhea within the first two weeks of life. The writers obtained positive complement-fixation (0.01 c. c.) and agglutination (0.002 c. c.) reactions from a prematurely born calf in an infected herd which died of scours when 10 days old. Experimentally, however, we were unable to produce any noticeable ill effects on two 3-day-old calves that were fed each with 90 c. c. of a *B. abortus* bouillon culture in milk for a period of 3 days.

## SUSCEPTIBILITY.

Cows of all ages are more or less susceptible to the disease. (See Tables 1 and 6.) Animals in their first or second pregnancies are more apt to abort if exposed than at any other time. Cows that have aborted once may abort a second time; abortion in the same cow more than twice is an unusual occurrence. Heifers from aborting mothers may be less susceptible than those born to noninfected dams; in fact, in one herd under observation such animals have shown a pronounced resistance to the infection. Cows and heifers reared in a noninfected environment very often abort shortly after being brought to infected premises.

## AGENTS OF DISSEMINATION.

Even before the discovery of the specific organism various observers had recognized the infective character of the afterbirth, fetus, and vaginal discharges from the aborting animals. Franck and Bräuer were able to produce abortion experimentally with afterbirth and vaginal discharge from aborting animals. The fact that the specific agent has now been isolated in a majority of cases from the gastro-intestinal tract, and at times from the liver and general circulation of the aborted fetus, places the product of conception prominently in this list. Milk has recently been added to the number of agencies by which the virus is eliminated from the body, as has already been referred to above. Thus the stall, litter, bedding, feed, water, pastures, stockyards, transportation cars and boats, attendants, their clothing, and various other objects can very readily become contaminated with one or more of the above-mentioned sources of infection, thereby acting as disseminators of the disease to other animals. The manure, if not composted properly and the outermost layer disinfected, may spread the disease to distant points. McFadyean and Stockman mention the possibility of foxes aborting as a result of infection with *Bacillus abortus* and acting as carriers of the infection. The same holds true in case of other animals, and especially with sheep and goats, since these animals have been claimed to abort not only as a result of experimental inoculation but also by pasturing or feeding on infected premises.

## NATURAL MODE OF INFECTION.

This important phase of the disease is and has been responsible for a great deal of discussion and diversified opinions.

Artificially the disease can be produced by introducing the virus into the body by way of the digestive tract and the vagina and by intravenous and subcutaneous inoculations. With the first two methods we are principally concerned, since the intravenous inoculation, while giving the greatest number of positive results, is purely an experimental method. The latter statement holds true for the subcutaneous inoculation, which gives few positive results, and, as proven by the English commission, requires rather too large a dose in the cow to be a probable occurrence naturally.

Nocard has also suggested the respiratory tract as a probable path of infection. The infection per orem has been considered an important natural avenue of infection by Bang,[2] Zwick,[29] Holth, and others, and particularly so by McFadyean and Stockman. W. L. Williams,[25] one of the stanchest supporters of the infection per vagina, claims that Bang and other workers, in their experiments to prove infection through the mouth, do not show how the infection of the vagina was excluded, stating that these ruminating animals upon which the experiments were conducted could easily transfer the infection from the oral cavity to the vagina by licking, a habit to which many cows are addicted. This same argument is, however, equally applicable in favor of infection through the mouth; that is, an animal infected artificially or naturally through the vagina may lick that organ or discharges from the same and thereby introduce the virus into the oral cavity. In favor of the infection by means of the vulvo-vaginal tract there is a great deal of clinical evidence, most conspicuous among which is the oft-quoted and classical case of Paulsen, where on a farm that had always been free from the disease 7 out of a herd of 16 cows were served by a bull from infected premises, causing abortion in 5 cows within 10 weeks, in one 3 months, and in one 4½ months after copulation.

Williams[26] bases his treatment of abortion, which is given in the publication cited, on the ground that infection takes place through the vaginal tract. Holth, quoting Wall's histologic findings, states that the latter found the mucous membrane in the spaces between the cotyledons to be affected in three cases, thereby indicating that the infection occurred through the cervix, since infection through the blood would locate itself first in the cotyledons.

Another class of abortion where the bull is most probably the carrier of the infection, and principally during copulation, is that occurring among range cattle. But while the bull during copulation can very easily transplant infection into the cervix and uterus, it

is hardly probable that infection from the vagina would readily pass through the rigid plug in the cervix after conception. If infection does take place after conception it probably does so by means of the lymphatic system of the vagina.

On a farm where the disease is not known to exist a new cow may be brought into the herd, or one of the cows of the herd may be taken to a bull on infected premises for service, and it often happens that not only the newly introduced cow or the one bred to the bull but others in the herd will drop their calves prematurely in quick succession, or give birth to calves that die at the age of several days. In such cases the infection must have taken place after conception, either by the genitals coming in contact with stalls, bedding, etc., contaminated with virus, or else the bacilli were introduced through the digestive tract by feed or drinking water containing the specific organism. And from the vast number of experimental abortions produced by introduction of virus through the mouth, particularly in animals such as rabbits, where the virus is introduced by tube and infection by vagina can be easily excluded, this means of infection must be given an important place, especially so until satisfactory experimental evidence is brought forward to the contrary.

## PATHOGENESIS.

No matter what the mode of natural infection may be, it is obvious that the bacillus of abortion shows a predilection for the mucous membrane of the uterus. If the infection is introduced during copulation the virus can readily be deposited in the cervical canal by the penis of the bull, from where it can easily gain entrance to the uterus. If the infection, on the other hand, finds its way into the alimentary tract, or into the genital tract after the closing of the os uterus, it is necessary for the virus, in order to reach the uterine mucous membrane, to be taken up by the lymphatics, whence it finds its way into the circulation and is finally planted on the mucous surface of the uterus. The multiplication and activities of this organism result in the injection and catarrh of the uterine mucous membrane and the formation of the characteristic yellowish to dark brown tenacious exudate on the surface, and in some instances an infiltration of the submucosa. The intervention of the exudate, or the necrotic changes of the cotyledons sometimes found, interfere with the osmotic changes between the fetal and maternal membranes, thus producing the death and expulsion of the fetus. The death of the fetus may also be occasioned by the entrance of the organism into the fetal circulation through the destroyed placental capillaries. The accumulation of a large amount of the exudate at the internal os may act as an irritant or as a solvent and cause the opening of the cervix and expulsion of

the fetus. Death of the fetus does not always cause its discharge, but it may be retained within the uterus, which results in its maceration or mummification.

The failure of aborting cows to breed may be explained by the persistence of the infection in the uterus, which prevents conception. However, failure to conceive can not always be traced back to infection with *Bacillus abortus*, as will be referred to later.

## PATHOLOGIC ANATOMY.

The one constant and characteristic pathologic change present in practically all cases of infectious abortion is a yellowish to dark brown exudate found between the uterine mucous membrane and the chorion, varying in consistency from a mucopurulent to a tenacious gluey substance. McFadyean and Stockman suggested that the color is probably due to the chromogenic properties of the organism. The exudate contains grayish-white flakes and is composed of detritus, leucocytes, and epithelial cells in various stages of retrogressive changes from granular degeneration to necrosis. Bacilli of abortion are found lying free and within the leucocytes. The quantity of the exudate varies greatly from a small, almost unobservable amount, principally around the cotyledons in the vicinity of the internal os, to a large quantity covering the entire gravid uterus. In many cases the nongravid horn is similarly involved. McFadyean and Stockman record a twin pregnancy in which one of the horns showed considerable exudate, while the other was apparently normal. The nature of the exudate only becomes changed in cases of mixed infections, but this is an exceedingly rare occurrence, and when present is occasioned by other diseased conditions or by the failure to expel the fetus soon after the cervical canal is opened.

The uterine mucous membrane, while apparently normal in a number of cases, is frequently swollen, injected, hemorrhagic, or roughened by a serofibrinous exudate, and in some instances may even show necrotic areas. The outer walls of the uterus have never been found to be involved. The submucosa in some cases is edematous. The cotyledons seem to receive the brunt of the attack, being in a great majority of cases reddened, or on the other hand pale, soft, and necrotic, and nearly always surrounded by the abortion exudate. The chorion and chorionic tufts, besides showing a subchorial edema, may show lesions similar to those described for the uterus and cotyledons. Oftentimes, however, the chorioallantoic tissues may have a lusterless, dead, opaque shrunken appearance. McFadyean and Stockman have found one natural and one experimental case in which the chorion was thickened and leathery in appearance. The umbilical cord in a good many instances shows a serohemorrhagic infiltration, but may on the other hand be apparently normal. The fetuses show a sero-

sanguineous infiltration of the abdominal or thoracic wall, or both, but principally of the former. A sanguineous-gelatinous exudate may be observed in the peritoneal and thoracic cavities, which is more marked in the former.

Unless there are general manifestations of septicemia, macroscopic changes are as a rule not observed in the visceral organs, excepting the gastrointestinal tract. A catarrhal gastroenteritis is the usual alteration. The contents of this tract are yellowish to brownish orange, tenacious in consistency, sticking closely to the walls. Upon standing overnight there appears a supernatant amber-colored fluid with a viscid brownish-orange sediment. The stomach contents resemble the abortion exudate found in the uterus, but are at times more highly colored. Cultures made from such material will invariably bring forth colonies of *Bacillus abortus*. In 15 attempts we have never obtained the specific organism from the blood of a fetus. The liver furnished cultures in one instance and the stomach contents in 11. The fetus in rare cases may be macerated or may become mummified. The process of mummification does not take long. McFadyean and Stockman found a mummified fetus in an experimental case 138 days after the infection. The allantoic and amniotic fluids may be turbid and contain flocculi.

## SYMPTOMS.

The period of incubation is another phase of the disease which varies within wide limits. The only definite information on this subject is found in the experimentally infected cases, unless we take the untenable ground that all infections are transmitted during copulation. From the artificially inoculated cases recorded by Lehnert, Bräuer, Bang, McFadyean and Stockman, and others we learn that the period varies from 1 to 33 weeks; McFadyean and Stockman's cases averaged 126 days. It matters little how the infection was introduced or whether the virus used was material from aborting cows or a pure culture, the period of incubation is irregular. The variation in part may be explained by the difference in virulence of the organisms and in the susceptibility of the individual. One must bear in mind, however, that the disease as a rule is chronic, and in such cases the disease processes have no doubt been existing long before abortion takes place.

Premonitory symptoms are not always observed, but when present are manifested two or three days before the expulsion of the fetus by swelling of udder ("making bag"), edematous swelling of the vulvar lips, reddening of and small inflamed nodular formations on the vulvo-vaginal mucosa, and the appearance of a mucoid or mucopurulent odorless discharge from the vagina. While all or most of these manifestations are present in a very large majority of cases of

infectious abortion they are not prima facie evidence that abortion will occur. The swelling of the udder would be noticed in non-milking cows only, and in heifers there is invariably a swelling of the bag beginning some months before parturition. The other symptoms are not infrequently observed in nonaborting animals. In a herd of 45 Holsteins, where the writers were conducting some experimental work, and where abortion and granular vaginitis were coexistent, several cows showed a discharge with reddening and nodular formation on the vulvo-vaginal mucous membrane. One case in particular showed a profuse vaginal discharge, intense inflammation of the vaginal mucous membrane, and swollen vulvar lips. The manager, an experienced dairyman, was warned of the approaching abortion, and he agreed that the fetus would be expelled within a day or two, but neither this cow nor other suspicious ones have as yet aborted. In an infected environment a large percentage of animals abort during the first or second pregnancy. Cows most often abort between the fifth and seventh months of gestation. Animals aborting for the first time usually do so at an earlier stage than do those with a history of previous abortion. In cases where the infection has persisted in the uterus, however, abortion occurs at an early stage of gestation. The abortion at a later stage in a subsequent pregnancy may be caused by a reinfection. Cows may abort a second time, but a third abortion in the same cow is rare.

There is no doubt that abortion during the early months occurs more frequently than is reported but is unnoticed and considered simply as "failing to catch." Should the abortion occur in the early months of gestation when the chorionic tufts are not yet fully developed, the fetus and its membranes are expelled at the same time and the act is attended by no systemic disturbance. However, if the abortion should occur in the late months of pregnancy, the afterbirth is generally retained, or at least not voided together with the fetus, and the abortion is attended with restlessness and pain on the part of the aborting animal.

The fetus is, as a rule, born dead; or if alive is usually weak and puny and dies within a few days with diarrheal symptoms or remains a runt. Nocard and others have reported that calves born alive before the full period of gestation has expired utter peculiar cries which simulate the howling of a rabid dog.

Following the abortion there is a dirty yellowish-gray, mucopurulent discharge which persists for two or more weeks. The retained placenta if not removed within a few days after the abortion may give rise to necrosis and subsequently to sapremia, or the changes may extend to the uterine mucosa, causing endometritis, and in some instances may involve the whole thickness of the uterus and even penetrate into the abdominal cavity and produce peritonitis. Chronic

metritis and pyometra may follow improper handling of the retained placenta. In a good number of cases cows may, to all appearances, recover from the effects of the abortion, the discharge and all inflammatory changes having ceased, but nevertheless they may fail to conceive and be brought to the bull several times before becoming impregnated, or may never again be successfully bred. Such condition is no doubt the result of retained placenta or endometritis in a great majority of cases. The failure to conceive for all time, or failure to conceive after one or more services, does not always mean that this condition is caused by an infection with *Bacillus abortus;* at least such inferences can not be drawn from our observations recorded in Table 1.

TABLE 1.—*Records of certain cows in two herds of 108 animals, in which infectious abortion has been prevalent for several years.*

| Cow No. | Complement-fixation test. | | | Agglutination test. | | | | History. |
|---|---|---|---|---|---|---|---|---|
| | 0.05 | 0.02 | 0.01 | 0.01 | 0.005 | 0.003 | 0.002 | |
| 1.... | − | − | − | − | − | − | − | Calved about 1¼ years before blood drawn for this test and has not conceived since. |
| 2.... | + | + | + | + | + | + | + | Dropped an 8-months fetus 10 months ago and has not conceived since. |
| 3.... | − | − | − | − | − | − | − | Calved 9 months ago; repeatedly bred since, but does not conceive. |
| 4.... | − | − | − | − | − | − | − | Do. |
| 5.... | − | − | − | − | − | − | − | Calved 7 months ago; repeatedly bred since but does not conceive. |
| 6.... | − | − | − | − | − | − | − | Calved 1 year ago; repeatedly bred since, but does not conceive. |
| 7.... | − | − | − | + | − | − | − | Do. |
| 8.... | − | − | − | − | − | − | − | Aborted a 2-months fetus 6 months ago; bred, but does not conceive. |
| 9.... | + | + | + | + | + | + | + | Calved 13 months ago; bred repeatedly, but does not conceive. |
| 10.... | − | − | − | − | − | − | − | Has not conceived for 16 months, even though bred repeatedly. |
| 11.... | + | + | + | + | + | + | + | Do. |
| 12.... | ? | − | − | − | − | − | − | Do. |
| 13.... | − | − | − | − | − | − | − | Has not conceived for 8 months, even though bred repeatedly. |
| 14.... | − | − | − | + | − | − | − | Never aborted; has given birth to 11 calves. In calf now, but was bred three times before conceiving. |
| 15.... | − | − | − | − | − | − | − | Never aborted; has given birth to 3 calves. In calf now, but was bred 3 times before conceiving. |
| 16.... | (1) | (1) | (1) | + | + | + | + | Aborted last 2 calves; first at 5 months, second at 7 months. In calf now, but was bred twice before conceiving. |
| 17.... | (1) | (1) | (1) | + | + | + | − | Never aborted; has given birth to 10 calves. In calf now, but was bred 6 times before conceiving. |
| 18.... | + | − | − | + | − | − | − | Aborted first calf; has given birth to 11 since. In calf now, but was bred 4 times before conceiving. |
| 19.... | + | + | − | + | + | + | + | Never aborted; has given birth to 6 calves. In calf now, but was bred 4 times before conceiving. |

[1] No test.

TABLE 1.—*Records of certain cows in two herds of 108 animals, etc.*—Continued.

| Cow No. | Complement-fixation test. | | | Agglutination test. | | | | History. |
|---|---|---|---|---|---|---|---|---|
| | 0.05 | 0.02 | 0.01 | 0,01 | 0.005 | 0.003 | 0.002 | |
| 20.... | (1) | (1) | (1) | − | − | − | − | Aborted first calf at 5 months; has given birth to 6 calves since. In calf now, but was bred twice before conceiving. |
| 21.... | + | − | − | + | ? | − | − | Never aborted; has given birth to 9 calves. In calf now, but was bred twice before conceiving. |
| 22.... | − | − | − | − | − | − | − | Never aborted; has given birth to 4 calves. In calf now, but was bred 3 times before conceiving. |
| 23.... | − | − | − | − | − | − | − | Never aborted; has given birth to 1 calf. Has been bred 3 times and is not yet with calf. |
| 24.... | + | + | + | + | + | + | + | Never aborted; has given birth to 1 calf. Was bred 3 times before conceiving. |
| 25.... | − | − | − | − | − | − | − | Never aborted; has given birth to 9 calves. Was bred 3 times before conceiving. |
| 26.... | + | + | + | + | + | + | + | Aborted her first calf; has given birth to 2 calves since. Bred twice before conceiving. |
| 27.... | − | − | − | − | − | − | − | Never aborted; has given birth to 6 calves. In calf now, but bred 3 times before conceiving. |
| 28.... | ..... | + | ..... | + | + | + | + | Had 3 calves; aborted her fourth at 3 months, 4 months ago, and previous to her last conception she was bred 4 times. |

[1] No test.

For interpretation of tests given in this table, see page 173.

This table shows that a number of cows that failed to conceive after one or more services did not give any reaction to the agglutination and complement-fixation tests. Hence the organism could not have been doing much damage to such a large percentage of animals so affected without their bodies defending themselves by producing bacteriolysins or agglutinins or both. The cause of such sterility must therefore, in some animals at least, be looked for elsewhere.

## DIAGNOSIS.

The premonitory symptoms as enumerated above are not always followed by abortion, and even when they are so followed they are not indicative of the presence of infectious abortion. Granular vaginitis, which has been accused by many workers as being responsible for abortion, may exhibit similar manifestations, but in these cases when abortion does occur the general opinion among most authors in recent literature is that such abortion is not directly traceable to the granular vaginitis, but to infection with *Bacillus abortus*. When a herd has a history showing that a number of cows abort during a season, one is justified in concluding for all practical purposes that he is dealing with infectious abortion. Such a diagnosis is also indicated if the disease was not known to exist on the farm until the introduction of a new bull or even a new cow, after which several cases of abortion occur.

W. L. Williams points out that abortions due to mechanical injuries are so rare that they may safely be eliminated as causative factors in most cases. He examined gravid uteri of 1,736 pregnant cows and heifers, and in spite of being on the lookout for injuries to the genital organs, he could not find a single case. He emphasizes the fact that these animals had been driven to railroad stations, loaded into cars, transported for many miles, and in many instances unloaded into stockyards, jostled and driven, and finally slaughtered. If such treatment does not induce abortion, the ordinary accidents, such as slip or jam or prod by attendant or riding by another cow, should not be held responsible for the slinking of the calf in many cases.

The constant presence of the abortion exudate may be of aid in making a diagnosis, but here we may be hampered by the chance of external contamination if the examination is not made soon after abortion. Where infectious abortion can not be diagnosed from history and clinical manifestations the following methods of diagnosis have been recommended: (1) Bacteriologic; (2) serologic; (3) allergic.

### BACTERIOLOGIC DIAGNOSIS.

Microscopically, most satisfactory results are obtained by examining smears made from the gastrointestinal contents of the fetus or from the discharge of the vagina before and soon after abortion. The presence of small, Gram negative, almost coccuslike bacilli in clumps is strongly suggestive of *Bacillus abortus*. Cultures made from similar material give in the majority of positive cases cultures of *B. abortus*, but negative results must not be taken as final proof of the absence of infectious abortion. Inoculation of guinea pigs either subcutaneously or intraperitoneally will in many instances produce tuberculouslike lesions in three or more months, from which *B. abortus* may be recovered. The last two methods are not practicable because of the time which elapses before results are obtained, this being especially true of the animal inoculations.

### SERUM DIAGNOSIS.

Following the success of serum diagnosis in other diseases, especially in glanders, various workers in veterinary pathology have applied the serologic tests—agglutination and complement-fixation—to abortion. Among these are McFadyean and Stockman, Grinsted, Holth, Wall, Brüll, and Zwick. In this country Larson was the first to report results of the complement-fixation test.[a] Both of these tests have been used in this and in other laboratories of the country. The serum is obtained, as in the case of glanders in horses, by bleeding

[a] Since this was written bulletins on the diagnosis of infectious abortion have been issued by Hadley and Beach, of the Wisconsin Experiment Station, and Surface, of the Kentucky Experiment Station.

the suspected animal from the jugular vein, allowing the blood to stand until the clear serum separates from the clot. Such serum may then be immediately used or placed in an ice chest, where it will remain unaffected for several months. One part of a 5 per cent solution of carbolic acid added to 9 parts of serum will preserve the serum, but ordinarily this is not necessary, and in fact uncarbolized clear serum is preferred by the writers for the application of the tests.

### THE AGGLUTINATION TEST.

Various limits have been placed on the lowest dilution of serum from animals which should be considered not as normal agglutinins, but as the result of infection with *Bacillus abortus*. MacFadyean and Stockman have placed the dilution at the very low limit of 1:25, but they conclude that the agglutination test can not be regarded as free from great risk of error. Grinsted considers that normal sera never agglutinate in dilutions higher than 1:30. Brüll concludes that sera from normal cattle agglutinate *B. abortus* in dilutions not higher than 1:32. Sera from animals affected with *B. abortus* show with few exceptions titres of 1:120 to 1:16,000. He believes that a titre of 1:64 can give no definite conclusions, since he obtained such titre in one case of abortion and in two normal animals.

Zwick states that just prior or for a time after abortion the serum will show agglutinating value in dilutions of 1:100 to 1:10,000, and that animals known to come from abortion-free environment never agglutinate in dilution of 1:100.

Both Holth and Wall suggest the advisability of using both the complement-fixation and agglutination tests, since the presence of normal agglutins are not apt to be coincidently present with normal bacteriolytic amboceptors. Wall gives the following formulas for reactions:

Positive reaction { Agglutination [a] $\geqq 0.05$ ; Complement-fixation $\geqq 0.05$

Negative reaction { Agglutination $= 0$ ; Complement-fixation $= 0$

or { Agglutination $\geqq 0.05$ ; Complement-fixation $= 0$

or { Agglutination $= 0$ ; Complement-fixation $\geqq 0.05$

The technic used by all the above-mentioned workers consists principally in making a series of dilutions in agglutination fluid and allowing them to stand for various lengths of time in the incubator and

[a] $\geqq 0.05$ represents a serum whose titre is equal to or greater than 0.05.

then reading the results. In our work we have followed the same technic as outlined by Muller, Miessner, and Pfeiler and also described by Mohler and Eichhorn[18] for glanders, differing from them principally in not reading the agglutinating titre of a particular serum according to dilution but considering the quantity of serum used as an index of the agglutination value. This was first suggested by Wall. For example, a serum is diluted to one-tenth of the original strength; then if 0.02 c. c. of this basic dilution will agglutinate in a tube to which 1 c. c. of agglutinating fluid is added, the agglutinating titre of such serum would be considered 0.002 instead of 1:500, because, should 1 or 2 c. c. or even 4 c. c. of salt solution be added to the tube containing 0.02 c. c. of the one-tenth dilution, there will still be a complete agglutination, whereas the dilution would now be 1:1,000 or 1:1,500 or higher. Even the addition of 2 c. c. of the agglutinating fluid instead of 1 c. c., which would make the dilution 1:1,000, does not affect the agglutination power of the serum (0.02 c. c. of a one-tenth dilution).

The agglutinating fluid is made from a week to 10-day old slant agar cultures (other workers use washed *Bacillus abortus* grown in fluid medium [serum bouillon]), washed with carbolized salt solution. Killing the culture by heating has not given us as good results as the fluids preserved simply by carbolization (0.5 per cent). More than one strain of the *B. abortus* has been used for our work, the best results being obtained by using three or four strains. The opacity of the fluid thus obtained is compared with the old titred agglutinating fluid. This is accomplished by filling two beakers of equal dimensions to the height of 2.5 to 3 centimeters with the old and new fluids, respectively. The beakers are placed on clear-cut printed matter, and by looking through them from above the density of the fluids can very readily be compared. Should the printing under the new fluid appear clearer than the old titred fluid, some more heavy bacterial suspension or bacterial growth should be added until the new fluid has the same opacity as the old. Should the new fluid be too turbid, it is thinned down by the addition of carbolized salt solution. The fluid now of the proper opacity is then subjected to titration by testing two or more sera, preferably of known agglutination titre with both new and old fluids, and if the results are similar the new fluid may be considered as suitable for the application of the agglutination test for infectious abortion. The fluid keeps well for at least two months when kept at a temperature of 4 to 6° C.

In making the test a series of six round-bottom test tubes that can be used for centrifugalization are placed in a test-tube stand, with conical-shaped holes at the bottom. One part of the serum to be tested is then added to 9 parts of carbolized salt solution. This known basic dilution is drawn into a 1 c. c. pipette, graduated into

hundredths, and the following amounts are placed in each of the six tubes:

First tube, 0.15 c. c., representing 0.015 of the original serum.
Second tube, 0.1 c. c., representing 0.01 of the original serum.
Third tube, 0.05 c. c., representing 0.005 of the original serum.
Fourth tube, 0.03 c. c., representing 0.003 of the original serum.
Fifth tube, 0.02 c. c., representing 0.002 of the original serum.
Sixth tube, 0.01 c. c., representing 0.001 of the original serum.

To each of these tubes 1 c. c. of the agglutinating fluid is added. Tubes are thoroughly shaken to wash off the serum that may be clinging to the sides of the tubes, and then they are placed in the incubator for from 20 to 30 minutes. This is followed by centrifugalization for 10 minutes at a speed of 1,600 revolutions per minute. The tubes are then placed back into the test-tube rack and held toward the light so that the bottom of the tubes can be read. Agglutination is indicated by the appearance of a more or less regular, thinly spread film at the bottom of the tube. The exact manner in which the agglutinated bacteria are distributed over the bottom of the tube depends largely upon the precise shape of the bottom. When the bottoms of tubes show a compact, round, grayish-white sediment of bacteria, it indicates failure of the serum to agglutinate. While results can be read soon after removal from the centrifuge, it is advisable to examine the tubes again after they have been allowed to stand overnight at room or ice-chest temperature, although in over 400 cases tested in this manner no difference was noticed between the results read soon after the centrifugalization and those read the day following.

While the serum of no known normal cow or steer has thus far given us a complete agglutinating value of 0.01 or complete agglutination in the second tube of the above series, still it is not advisable to consider any cases with such titre as positive on the strength of the agglutination test alone. At present to call a case positive we demand that the serum should show a titre of at least 0.005. Especially is this procedure advisable in case a herd of cows are tested and not one serum of the lot gives a titre higher than 0.01. Agglutinins may exist before abortion in serum of animals and especially so soon after abortion. They may persist for two years, but they gradually begin to decrease several months after the abortion. Grinsted concludes that serum showing a titre of 1:1,800 indicates a recent infection, and therefore a probable case of abortion if the animal is pregnant.

### THE COMPLEMENT-FIXATION TEST.

McFadyean and Stockman were the first to use the complement-fixation test as an aid in diagnosing infectious abortion, but Wall and Holth did exhaustive work with and perfected the technic of

the complement-fixation test in this disease. In this country Larson [13] used practically the same method as described by both Wall and Holth with but slight modification, and the procedure in this laboratory [17] differs only in detail from that first described by Wall.[a]

*The hemolytic system.*—Since this laboratory is applying almost daily the complement-fixation test for glanders, it was deemed advisable to use the same hemolytic system for the test in infectious abortion as in glanders; therefore, washed red cells of sheep, hemolysins furnished by sera of rabbits immunized against sheep erythocytes, and complement from guinea pigs constitute the active ingredients of the hemolytic system.

In our work on this disease (Tables 3, 4, and 5) sensitized red blood cells are used. Sensitizing the red cells is accomplished by adding to washed red cells of sheep sufficient hemolysin to sensitize the desired quantity of blood. Thus, to 5 c. c. of washed red blood cells, which make 100 c. c. of 5 per cent solution (the desired suspension for the work in glanders, as indicated in Bulletin 136), there would be required 0.05 c. c. of a hemolysin which is used in the glanders test in dilutions of 1:2,000. The 0.05 c. c. of such hemolysin (rabbit serum) is dissolved in a suitable quantity of normal salt solution (about 50 c. c.); to this the 5 c. c. of washed sheep red cells are added, and the product is incubated at 37.5° C. for 1 to 1½ hours. The whole product is then centrifugalized, the supernatant fluid drawn off, and the red cells washed by adding salt solution and again centrifugalizing; this is again repeated. After the supernatant fluid is drawn off for the third time the tube with the washed red cells at the bottom is placed in the ice chest and dilutions made when desired. When the red cells are not sensitized the following table from Holth represents a scheme for titrating the hemolysins:

TABLE 2.—*Method of titrating hemolysins.*

| Tube. | Complement, 1:4 dilution. | Hemolysin, diluted 1:100. | Salt solution, 0.9 per cent. | Sheep corpuscles, 1 per cent. | Degree of hemolysis. |
|---|---|---|---|---|---|
| | *C. c.* | *C. c.* | *C. c.* | *C. c.* | |
| 1 | [b] 0.06 | 0.2 | 1.5 | 0.5 | Complete. |
| 2 | .06 | .15 | 1.5 | .5 | Do. |
| 3 | .06 | .10 | 1.5 | .5 | Do. |
| 4 | .06 | .05 | 1.5 | .5 | Partial. |
| 5 | .06 | .03 | 1.5 | .5 | None. |
| 6 | ..... | .3 | 1.5 | .5 | None; control for hemolysin. |

The titre of hemolysin according to the foregoing table would be 0.1, but the dose for each tube would be 0.25 c. c. A 1 per cent dilu-

[a] For the principles involved in this test the reader is referred to Bureau of Animal Industry Bulletin 136.

[b] This represents the dose of a titred complement. Wall uses instead 0.1 c. c. of 1:4 complement in his hemolysin titration scheme.

tion of red cells, which is recommended by Wall and used also by Holth and Larson, has been employed in this laboratory, although often a 2 and at times also a 5 per cent dilution have been used. The red cells both in concentrated as well as in diluted form, protected from light, keep well for 5 or 6 days at 4° to 6° C.

The complement, the third ingredient of the hemolytic system, is obtained as in the test for glanders by bleeding a guinea pig into a centrifuge tube by severing both the carotid artery and the jugular vein, after the animal has been stunned by a blow on the head. The blood is either allowed to stand over night in the ice chest for the separation of the serum or the blood after clotting is loosened from the sides of the tube and then centrifugalized and the serum pipetted off and diluted in the proportion of 1 to 4 of salt solution. The complement, although a nonstable substance, does not depreciate appreciably within 24 or 30 hours. The complement should, however, be titrated on the day the test is made. The titration is outlined in Table 3.

TABLE 3.—*Titration of complement.*

| Tube. | Guinea-pig serum (complement), diluted 1:4. | Salt solution, 0.9 per cent. | Sensitized red corpuscles, sheep, 1 per cent. | Degree of hemolysis. | Remarks. |
|---|---|---|---|---|---|
| | *C. c.* | *C. c.* | *C. c.* | | |
| 1 | 0.08 | 1.5 | 0.5 | Complete | |
| 2 | .06 | 1.5 | .5 | do | |
| 3 | .04 | 1.5 | .5 | do | |
| 4 | .03 | 1.5 | .5 | Almost complete | |
| 5 | .02 | 1.5 | .5 | Partial | |
| 6 | .01 | 1.5 | .5 | None | |
| 7 | | 1.5 | .5 | do | Control on sensitized corpuscles. |
| 8[1] | .08 | 1.5 | [2].5 | do | Control on complement. |

[1] This control can be omitted, but since we always have on hand nonsensitized washed red cells of sheep we include it in the test.

[2] Nonsensitized.

The ingredients are added in the same order as given in the table, then incubated at 37.5° C. for 1 hour, and then the evaluation of the complement is read. The titre according to the table would be 0.04 c. c., but in the final test 0.06 c. c. (the next largest quantity) would be used to each tube. This allowance was found necessary in order to produce complete hemolysis in our antigen controls (Table 5). The normal serum of cattle enhances the action of the complement in this hemolytic system. This was proven on several occasions when two series of complement titrations were executed, one series with and the other without the presence of normal inactivated cattle serum. The tubes of the series which contained the inactivated cow

serum invariably gave higher degrees of hemolysis than tubes containing the same amount of complement but no cattle serum.

*The final tests.*—The antigen used in the final test as prepared by the majority of workers is a serum bouillon culture of *Bacillus abortus* as recommended by Wall, which is preserved by adding 10 c. c. of 5 per cent phenol solution (or 10 c. c. of a solution composed of 5 parts of phenol, 10 parts of glycerin, and 85 parts of salt solution) to each 90 c. c. of such culture. Holth has used with equal success a filtrate of serum bouillon culture, suspension of bacteria in salt solution, alcoholic precipitate of filtrate dissolved in salt solution, and magnesium sulphate precipitation of filtrate. The writers have used glycerin bouillon culture 4 to 5 weeks old carbolized to 0.5 per cent, agglutination fluid, and the alcoholic precipitate of filtrate of Holth. While all three have given good results, the first is readily prepared and therefore most desirable.

The titration of the antigen is executed according to Table 4.

TABLE 4.—*Titration of antigen.*

| Tube. | Antigen. | Inactivated serum of infected cow. | Complement[1] and salt solution, 0.9 per cent. | Incubation. | Sensitized red corpuscles of sheep, 1 per cent. | Incubation. | Degree of hemolysis. |
|---|---|---|---|---|---|---|---|
| | *C. c.* | *C. c.* | *C. c.* | | *C. c.* | | |
| 1 | 0.5 | 0.02 | 1.5 | Placed in incubator at 37.5° C. for 1 hour. | 0.5 | Placed in incubator at 37.5° C. for 2 hours. | None. |
| 2 | .3 | .02 | 1.5 | | .5 | | Do. |
| 3 | .2 | .02 | 1.5 | | .5 | | Do. |
| 4 | .1 | .02 | 1.5 | | .5 | | Do. |
| 5 | .05 | .02 | 1.5 | | .5 | | Do. |
| 6 | .02 | .02 | 1.5 | | .5 | | Partial. |
| 7 | .01 | .02 | 1.5 | | .5 | | Complete. |
| 8[2] | ..... | .02 | 1.5 | | .5 | | Do. |

[1] The complement for this titration should be titred and the same dose as would be used in the final test should be used here. In order to facilitate matters the complement is added to the salt solution, so that each tube should receive the desired amount of complement plus the salt solution, the dose being made equal to 1.5 c. c.

[2] Tube 8 is a control on the serum.

Besides establishing the fixing quantity of antigen in the presence of a specific antibody, it is also desirable to establish the largest amount of antigen that may be used without inhibiting hemolysis, and for this purpose a similar series of tubes with ingredients as above described is used, differing only in using a serum from a non-infected animal and twice the dose of antigen in each respective tube. The fixing titre of the antigen in the presence of specific antibodies according to the above titration is 0.05, and the dose to be used in each tube may be made 0.15 or 0.2; provided, however, that the series executed with normal serum shows that twice that dose, that is, neither 0.3 c. c. nor 0.4 c. c. of antigen, will inhibit hemolysis. In the work

with the hemolytic system as used by us it was always necessary to make an allowance for the fact that the serum of normal cattle enhances the hemolysis. In fact, of late we have established the amount of antigen that will not inhibit hemolysis in a series similar to Table 4, but with double the amounts of antigen and the omission of serum in all but the last tube.

TABLE 5.—*Final complement-fixation test and titration of suspected serum.*

| Tube. | Inactivated suspected serum. | Antigen. | Complement and salt solution. | Incubation. | Sensitized red cells, 1 per cent. | Incubation. | Degree of hemolysis. |
|---|---|---|---|---|---|---|---|
| | *C. c.* | *C. c.* | *C. c.* | | *C. c.* | | |
| 1 | 0.1 | 0.15 | 1.5 | Placed in incubator at 37.5° C. for 1 hour. | 0.5 | Placed in incubator at 37.5° C. for 1 or 2 hours. | None. |
| 2 | .05 | .15 | 1.5 | | .5 | | Do. |
| 3 | .02 | .15 | 1.5 | | .5 | | Do. |
| 4 | .01 | .15 | 1.5 | | .5 | | Do. |
| 5 | .005 | .15 | 1.5 | | .5 | | Do. |
| 6 | .002 | .15 | 1.5 | | .5 | | Partial. |
| 7 | .001 | .15 | 1.5 | | .5 | | Complete. |
| 8 | | .15 | 1.5 | | .5 | | Do. |
| 9 | | .3 | 1.5 | | .5 | | Do. |
| 10 | | | 1.5 | | .5 | | Do. |

Table 5 represents the final test in complement fixation and also the titration of a suspected serum. After the tubes are placed in the incubator for the second time they are allowed to remain there for from one to two hours, when results are read. The complete settling down of the corpuscles in tubes when hemolysis is not complete or altogether absent, will not be observed for several hours. In ordinary routine test tubes 1, 5, 6, and 7 are omitted and in their stead one tube containing the same as tube No. 2 but no antigen is used, which acts as a serum control, and this serum control must in all instances show complete hemolysis. Tube No. 8 is a control on the antigen dose. Tube No. 9 is a control on twice the antigen dose; No. 10 is a control on the hemolytic system. A known positive and a known negative is included whenever the test is applied to one or more suspected sera. This is a desirable step especially if all sera tested on one occasion give either positive or negative reactions and inasmuch as the antigen is titrated but once in every 4 or 5 weeks.

*Interpretation of results.*—1. Complete fixation of complement with serum in quantities of 0.02 c. c. or less should be considered as positive.

2. Partial fixation in 0.02 c. c. and complete in 0.05 c. c. should be considered as very suspicious and the agglutination test should be applied to the serum. If such serum shows agglutination in tubes containing 0.01 c. c. or less it may be considered positive. Should

it fail to agglutinate in quantities of 0.01 c. c. or less, another sample should be taken at the end of 2 weeks.

3. Sera failing to show a fixation titre of 0.05 c. c. quantity but giving an agglutination in 0.005 c. c. or in smaller quantities should be considered positive.

In over 400 cases the agglutination test failed to show positive results in only one case where a positive reaction was ascertained by the complement-fixation test, while conversely the latter test failed in four cases which were positive to agglutination, indicating in the latter tests that the agglutinins probably appear earlier in the infection than do the bacteriolytic antibodies. In view of these results it seems from our experience that the agglutination test alone, which can be carried out very readily with inexpensive apparatus and requires no great amount of time owing to the simplicity of the technic, would appeal to all interested parties, and only in doubtful cases would it be necessary to refer to the more complex complement-fixation test. A positive reaction to complement-fixation and agglutination tests does not prove whether the animal has aborted or is going to abort, but it does indicate that the animal is at present or has been infected with *Bacillus abortus*. In a general way it may be stated that in herds where infectious abortion is unknown no positive reaction has thus far been obtained.

In a few instances a positive reaction was not obtained in one or two aborting cows upon infected premises. In one case when negative results were obtained the exudate, fetal membranes, and discharge collected by one of the writers failed to reveal the presence of *B. abortus* after a careful search both microscopically and bacteriologically, suggesting that not all abortions are induced by the presence of *B. abortus*. In a herd of 25 cows where abortion had never been known to the best of the owner's knowledge, but where new stock had been added during the past year, 6 animals both new and old aborted, and the sera from every one gave high fixing and agglutinating titres.

The blood from 20 steers examined for the purpose of establishing the agglutinating power of normal cattle serum failed to show a single case where such serum had an agglutinating value of 0.01.

With few exceptions a positive or negative reaction when obtained will be observed with both tests. The agglutinating titre has been observed in many cases to be 10 times that of the fixing titre; thus a positive serum possessing a fixing titre of 0.02 will frequently possess an agglutinating titre of 0.002.

### OTHER BIOLOGICAL TESTS.

Holth recommends the inoculation of the exudate from an aborting cow into a rabbit and that at the end of 7 days there will be a per-

ceptible increase of agglutinins and bacteriolytic amboceptors in positive cases.

### ALLERGIC REACTION.

McFadyean and Stockman recommend for trial "abortin" as a diagnostic agent. "Abortin" is a material analogous to tuberculin and when injected subcutaneously or intravenously in 5 to 10 c. c. doses should give a rise of temperature to 104° F. or over within a few hours after the injection, in positive cases. The number of cases tested by McFadyean and Stockman were too meager to establish any definite conclusions, and they state that "it will be necessary to carry out a large number of tests in practice before deciding upon this method of diagnosis."

De Vine,[5] assisted by Malcolm, put "abortin" prepared by McFadyean and Stockman to a practical test with rather unsatisfactory results. Zwick did not find this agent reliable. Nonreacting animals would abort, and no reaction would be obtained in aborting animals. He also found disagreements between the "abortin" reaction on the one hand and the agglutination test on the other hand. We have prepared an "abortin" which we injected into cattle at the Bureau Experiment Station, and from the results obtained with our product it could not be considered nearly as reliable as either the agglutination or the complement-fixation test.

### PREVENTION AND TREATMENT.

The principal method of treating infectious abortion is through prevention. No medicinal treatment has thus far been discovered for the cure of this disease, and the best methods of disinfection known to science are required to eradicate it from a herd. These procedures should be executed with the most exacting care and should include the disinfection of the animals as well as their surroundings.

When the disease has made its appearance in a stable the healthy cows should be changed preferably to an uninfected stable or premises. This is frequently difficult to carry out, and where it is not possible the aborting cows should be kept by themselves in another stable, or in an isolated portion of the stable with a temporary partition separating them from the healthy animals. Separate attendants should be provided for each herd, and there should be no communication of any kind between the two herds. If a cow develops prodromal symptoms of abortion she should be removed at once to the infected stable.

As soon as an animal has aborted, the fetus and membranes should be immediately carried away and destroyed by either burning or deep burial after covering with lime, as the abortion bacilli are extremely

numerous in these tissues. The vaginal discharge which follows is likewise very virulent and therefore should be disinfected, while the genital passages of the cow should be irrigated with an antiseptic solution and the animal kept from coming in contact with healthy cattle. The afterbirth, which is retained in most abortions occurring during the later months of pregnancy, should be removed within a few days. If it does not come away readily, do not forcibly remove it, but irrigate the uterus with a gallon or two of a warm disinfectant solution twice daily. This irrigation of the genitals is best accomplished by means of a soft rubber tube introdueed into the vagina, and if possible into the uterus, with a funnel in its outer elevated end. About 1 gallon or more of a one-half to one-quarter per cent solution of liquor cresolis compositus, lysol, or trikresol, 1 per cent solution of creolin or carbolic acid, or 1 to 1,000 potassium permanganate solution, should be introduced into the womb, and this treatment should be repeated every day so long as any discharge is observed from the cow. Afterwards it should be used once weekly until it is time to breed the animal. In addition this cow, as well as every cow in the stable, should be sponged every morning around the vulva, anus, perineum, and root of the tail with a disinfectant solution twice as strong as that used for irrigating the genitals. Furthermore, every cow in an infected herd should have the genital tract irrigated as above, even after an apparently normal parturition. W. L. Williams reports very good results from using one-fourth to one-half per cent Lugol's solution for irrigating the vagina during one estrual interval—that is, a period of 21 days—before breeding. The use of this solution is said not to prevent conception even if used one hour before service.

It is not advisable to breed a cow for at least two months after she has aborted, and not even then if the discharge has not ceased. If these precautions are neglected and the bull is allowed to serve the cow as soon as she comes in heat after aborting, the uterus will not be normal, and the animal will not conceive or the fetus will be expelled when quite small, while in a short time the cow comes in heat again. These very early abortions are as a rule not noticed, but as the system of the cow adapts itself to the infection, either through tolerance, immunity, or a loss of virulence of the bacilli, the period of retention becomes longer and longer, until finally the cow is immune and carries the fetus the full term of gestation. It generally requires from two to three years for the cow to become immune and even then there is a possibility of the cow acting as a carrier of the virus, and the bull which during that time serves this cow may transmit the infection to all other cows that he may cover if precautions are not taken to prevent it. For this reason it is not

advisable to sell or otherwise dispose of the animals that abort and replace them with new cows, as such new animals are very likely to become infected. (See Table 6.) Only those which after treatment prove to be permanently sterile should be prepared for the butcher.

In order to prevent a bull from carrying the infection from a diseased to a healthy cow, it is necessary to irrigate and disinfect the sheath and penis before and after each service. Following the clipping of the long tuft of hair from the opening of the sheath, the end of a small rubber hose is inserted into the sheath and the foreskin held together with the hand to prevent the fluid from flowing out again immediately. The other end of the hose contains the funnel, into which any of the above-mentioned antiseptics used in irrigating the vagina is poured, and the prepuce sack is flushed out. The injection may also be made by means of a common fountain syringe with a long nozzle. The skin of the abdomen around the sheath should likewise be sponged with a disinfectant.

When a stable has become infected, it should be carefully and thoroughly disinfected. The cattle should be removed and the stable kept empty for two or more days. The walls, floors, and gutters should be scrubbed and the ceiling brushed clean of dust and cobwebs, and then a 3 per cent solution of liquor cresolis compositus, lysol, carbolic acid, etc., should be applied with a force or spray pump so as to force the disinfectant into the cracks and crevices. This disinfection should be repeated after each abortion. In addition to the above measures it is necessary to clean out the barnyard, removing the manure and contaminated litter to some field not accessible to cattle, where it is plowed under. The surface of the yard should be sprinkled with a solution of copper sulphate, 5 ounces to a gallon of water. Milking stools and other implements should also be thoroughly disinfected.

Great care should be taken to guard against cows or bulls from another aborting herd, and workmen who have attended such a herd should be made to wash and disinfect their clothes and persons before going into a healthy herd. The purchase of infected cattle may at the present time be prevented by demanding that such animals shall come from a herd, the members of which show a negative reaction to the complement-fixation and agglutination test for infectious abortion. Otherwise, all newly purchased cows should be kept separate from the healthy herd until they have calved.

It is not to be expected that this disease can be suppressed at once, but by keeping up the above treatment the losses will be diminished and the disease finally eradicated.

With reference to medicinal treatment, various agents have been recommended and heralded as specifics from time to time, but the beneficial results attending their use may be attributed more to the

nature of the disease or errors of diagnosis than to the therapeutic action of the drugs. In some cases similar to those cited in the chapter on Symptoms it appears that the cows are preparing to abort, and if any drug should be used at this time, credit would probably be given the remedy as the cause of the continuation of pregnancy, whereas such symptoms may abate without medication. Carbolic acid has been the most widely recommended agent in the treatment of this disease, and good results have been reported by subcutaneous injections of 2 drams of a 2 per cent solution every week until 12 injections have been made. The most suitable place for the injection is on the side of the neck. Range cattle may be more readily treated by the use of medicated salt placed in troughs accessible to the cattle. This salt may be prepared by pouring 4 ounces of liquefied crude carbolic acid upon 12 quarts of ordinary barrel salt and mixing thoroughly. The reported success of this carbolic acid treatment is probably more the result of the tolerance or immunity to the disease which occurs after several abortions rather than the effect of the remedy itself.

## IMMUNIZATION.

A careful examination of various herdbooks will show that cattle rarely abort more than two or three times, after which they develop a tolerance or resistance to the infection and carry the fetus to the normal termination of pregnancy. In this manner the disease will gradually exhaust itself after several years, providing susceptible animals are not purchased and added to the herd. It is this tendency toward natural immunity of the infected cattle which has raised the question of the production of an artificial immunity by various methods of procedure. Bang's investigations along this line indicate the possibility of securing such immunization in cattle as well as sheep and goats. He worked with both living and dead cultures of the causative bacillus and injected them intravenously and subcutaneously. McFadyean and Stockman have also experimented with the same purpose in view and have obtained encouraging results from the use of large doses of a virulent culture subcutaneously six to eight weeks before breeding.

The writers have been conducting a number of experiments on five large dairy herds in an endeavor to find a suitable biologic product for immunization and control of this disease, and to this end suspensions of abortion bacilli killed by heat or carbolic acid (0.5 per cent), or those no longer viable on account of age, were injected as above mentioned as well as intraperitoneally and by ingestion. Some of the experiments were performed on animals at various intervals before breeding and in other cases both before and after breeding. It should

be remembered that complete immunity by natural infection is slow in development, for whereas one active siege of the disease, as manifested by an abortion or possibly by a retained afterbirth, produces immunity in many instances, nevertheless in a considerable number of cases immunity occurs only after a prolonged siege or reinfection, as manifested by two or more abortions in the same animal. (See Table 6.) In view of these facts the writers have further extended their efforts toward fortifying the infected or exposed animals during pregnancy by the use of dead or avirulent bacteria, thereby stimulating not only the production of bacteriologic and other antibodies, but also the increase of the opsonic index. Over 250 head of cattle have been thus treated from three to five times, but only a very small proportion of this number have as yet calved. In a small herd treated early in this work the results were not encouraging, but failure in those cases may be attributed to the facts that a very thin suspension of bacterin had been injected and, secondly, just one strain had been used in the preparation of the product. Since the different strains have been found to vary somewhat, subsequent experiments have been conducted with denser suspensions made from a number of the most virulent strains, and the preliminary results thus far obtained with these injected cattle have been more satisfactory. For a more definite decision on the value of this line of vaccination the results of the treatment of the latter animals must be awaited, but the outlook for prophylactic treatment along this line is somewhat encouraging and will furnish a basis of a separate report as soon as the investigation is completed. Studies are also being conducted with reference to the immunizing effect which infected milk from a "bacillus carrier" mother will have upon the calf when it becomes adult.

Table 6, on the next page, gives the histories of certain cows in a herd affected with infectious abortion, showing a number of cases in which tolerance or natural immunity has been acquired.

We desire to express our indebtedness to Dr. J. P. Turner, veterinarian in the health department of the District of Columbia, for various courtesies extended in connection with the study of infectious abortion, and especially for the information contained in this table. Dr. Turner states that several cows which recently aborted but which have not as yet been bred are not mentioned in the table. A number of the cows mentioned that have either aborted or gone the full period in 1912 are again with calf.

TABLE 6.—*Records of aborting cows in a herd affected with infectious abortion.*

| No. | Date of introduction into herd. | Age at that time. | Pregnancies in 1908. | Pregnancies in 1909. | Pregnancies in 1910. | Pregnancies in 1911. | Pregnancies in 1912. | Disposition of animal. |
|---|---|---|---|---|---|---|---|---|
| | | *Years.* | | | | | | |
| 6 | June 26, 1907 | 7 | Full period | Aborted, 5 months | Full period | Full period | Full period | Still in herd. |
| 22 | 1908 | 10 | do | Aborted, 7 months | do | Aborted, 8 months | | Sold, 1912; poor milker. |
| 28 | 1908 | 6 | Aborted, 7½ months | Full period | | | | Sold, 1910; poor milker. |
| 37 | 1908 | 8 | Full period | do | Full period | Aborted, 7 months | | Sold, 1912; poor milker. |
| 57 | 1908 | 12 | do | do | Aborted, 6 months | | | Sold, 1910; poor milker. |
| 62 | 1908 | 8 | Aborted, 8 months | | | | | Sold, 1909; poor milker. |
| 66 | Jan. 27, 1908 | 6 | | Full period | Aborted, 7 months | Full period | Full period | Still in herd. |
| 80 | do | | | do | Aborted, 6 months | | | Sold, 1911; poor milker and failed to breed. |
| 93 | 1908 | 13 | Full period | do | Aborted, 5 months | | | Sold, 1910; poor milker. |
| 99 | Jan. 18, 1907 | 9 | do | Aborted, 7 months | | | | Sold, 1909; poor milker. |
| 100 | 1908 | 12 | do | 8 months | | | | Sold, 1910; poor milker. |
| 133 | 1908 | 11 | do | Full period | Full period | Full period | Aborted, 8 months | Still in herd. |
| 136 | 1908 | 6 | do | do | Aborted, 7 months | | | Sold, 1910; poor milker. |
| 147 | June 20, 1908 | 5 | | do | do | Full period | Full period | Still in herd. |
| 155 | June 27, 1908 | 2 | Full period | do | Aborted, about 6 months. | do | do | Do. |
| 158 | June 2, 1908 | 6 | | Aborted, 7 months | Full period | do | | Sold, 1912; poor milker. |
| 167 | July 10, 1908 | 5 | | Full period | Aborted, 8 months | do | Now past eighth month. | Still in herd. |
| 170 | do | 5 | | Aborted; age not known. | | do | Full period | Do. |
| 171 | do | 5 | | Aborted, 6 months | Full period | do | | Sodl, 1912; unprofitable. |
| 173 | do | 4 | | Full period | Full period | Aborted, 5 months | Now in fourth month. | Do. |
| 175 | do | 6 | | Aborted, 4 months | Aborted, 5 months | Full period | | Do. |
| 178 | July, 1908 | 6 | Full period | Aborted, 6½ months | | | | Sold, 1910; poor milker. |
| 181 | Nov. 20, 1909 | 7 | | Full period | Aborted, 7 months | | | Sold, 1911; poor milker. |
| 182 | do | 4 | | | Aborted, 5 months | Full period | Full period | Still in herd. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 187 | May 9,1909 | 6 | ..... | Full period..... | Full period..... | Aborted, 7 months.. | ..... | Sold, 1912; poor milker. |
| 190 | .....do..... | 6 | ..... | ..... | .....do..... | Aborted, 6 months.. | ..... | Sold; failed to breed and poor milker. |
| 192 | .....do..... | 5 | ..... | Full period..... | .....do..... | Aborted, 7 months.. | Full period..... | Still in herd. |
| 194 | .....do..... | 6 | ..... | .....do..... | Aborted, 7½ months... | Full period..... | .....do..... | Do. |
| 195 | May 21,1909 | 6 | ..... | ..... | Aborted, 8 months.... | ..... | ..... | Sold, 1910; poor milker. |
| 199 | May 22,1909 | 3 | ..... | ..... | Aborted, 6 months.... | ..... | ..... | Do. |
| 202 | May 30,1909 | 5 | ..... | ..... | Full period..... | Aborted, 5 months.. | ..... | Sold; poor milker. |
| 203 | .....do..... | 6 | ..... | ..... | Aborted, 8 months.... | Full period..... | Full period..... | Still in herd. |
| 207 | June 16,1909 | 4 | ..... | ..... | Aborted, 6 months.... | ..... | ..... | Died, 1910. |
| 209 | .....do..... | ..... | ..... | ..... | Aborted, 8 months.... | ..... | ..... | Sold; poor milker. |
| 218 | June 26,1910 | 5 | ..... | ..... | ..... | Aborted, 4 months.. | Full period..... | |
| 221 | .....do..... | 6 | ..... | ..... | ..... | Full period..... | Aborted, 6 months.. | Sold, 1912; poor milker. |
| 222 | .....do..... | 5 | ..... | ..... | ..... | Aborted, 6 months.. | Full period..... | Still in herd. |
| 223 | .....do..... | 5 | ..... | ..... | ..... | .....do..... | .....do..... | Do. |
| 227 | Dec. 2,1907[1] | ..... | ..... | Aborted; pasture bred. | ..... | Full period..... | .....do..... | Do. |
| 239 | July —,1908[1] | ..... | ..... | ..... | Aborted; pasture bred. | .....do..... | ..... | Sold, 1912; poor milker. |
| 242 | Sept. 5,1908[1] | ..... | ..... | ..... | Full period..... | Aborted, 7 months.. | ..... | Sold; poor milker. |
| 250 | Nov. 29,1908[1] | ..... | ..... | ..... | Aborted; pasture bred. | ..... | Full period..... | Still in herd. |
| 253 | Dec. 7,1908[1] | ..... | ..... | ..... | .....do..... | ..... | .....do..... | |
| 254 | Jan. 14,1909[1] | ..... | ..... | ..... | ..... | Full period..... | Aborted, 6 months.. | Still in herd. |
| 258 | Mar. 15,1909[1] | ..... | ..... | ..... | ..... | Full period; then aborted at 5 months. | Aborted, 5 months.. | Do. |
| 262 | May 2,1909[1] | ..... | ..... | ..... | ..... | ..... | Aborted; pasture bred. | Do. |
| 297 | Sept. 21,1910 | 7 | ..... | ..... | ..... | Aborted, 7 months.. | Full period..... | Do. |
| 320 | June 26,1910 | ..... | ..... | ..... | ..... | ..... | Aborted, 8 months.. | Do. |
| 323 | .....do..... | ..... | ..... | ..... | Full period..... | Aborted, 7 months.. | Full period..... | Do. |
| 326 | .....do..... | ..... | ..... | ..... | ..... | Full period..... | Aborted, almost 9 months. | Do. |
| 352 | Nov. 21,1910 | 4 | ..... | ..... | Full period..... | Aborted, 6 months.. | Aborted, 7 months.. | Do. |

[1] Date of birth. An examination of this herdbook further shows that only one aborting heifer (239) was produced by an aborting mother (178). With this exception all the aborting cows gave birth to heifers which have records of from 1 to 3 successful pregnancies without any abortions.

## MEAT INSPECTION.

From the standpoint of meat inspection it is impossible to tell without any history whether an animal is or is not affected with infectious abortion merely from an ante-mortem or post-mortem examination by the inspector. The causes for condemnation in these cases would be such complications as sapremia, puerperal septicemia, metritis, endo-metritis, retained placenta, peritonitis, pyometra, mummification of the fetus, and other similar conditions which may be observed in this disease.

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# IMMUNIZATION TESTS IN TETANUS.

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## INTRODUCTION.

With the discovery of the cause of tetanus by Nicolaier in 1884 and the successful experiments on immunization by Kitasato and Von Behring in 1890 a wonderful advance was made in our knowledge of this disease. This fundamental information enabled investigators to apply themselves to a line of study which resulted in the comprehensive knowledge now at our command concerning the pathogenesis of the affection. The practicing veterinarian has no longer to fear the development of this dreaded disease subsequent to operative or traumatic wounds, as he is assured protection for his patients by the injection of a preventive dose of tetanus antitoxin. It is regrettable, however, that this method of prophylaxis which to-day is probably the most certain in preventive medicine is not used to a more general extent, especially in localities where the disease is very prevalent. The results of the investigations described below afford conclusive evidence that the injection of a certain amount of tetanus antitoxin prevents the development of tetanus even after heavy artificial infections with tetanus bacilli and spores which without the use of antitoxin produce death in the control animals. The object of these experiments was to determine the minimum amount of antitoxin, that is, the smallest number of units, which would be necessary to protect a horse against a fatal infection with tetanus, repeating as nearly as possible those conditions which obtain in natural infection.

## MODE OF INFECTION.

The infection with tetanus occurs as a rule through wounds or abrasions of the skin or mucous membranes in which necrotic or suppurating processes are in progress. Healthy, living animal tissues are not a suitable medium for the multiplication of the tetanus bacilli. The penetration of the organism into such wounds, which usually occurs with particles of dirt or manure, affords the anaerobic tetanus bacillus a favorable opportunity for its propagation and the spores a good field for germination and subsequent multiplication.

The wide dissemination of the tetanus bacillus in all sections naturally facilitates the occurrence of the infection. It may be carried into the body by the direct contact of wounds with infected material, or the infection may be introduced into the depths of the wounds at the time of the injury by such bodies as nails, splinters, etc. In such instances the multiplication of the bacillus is favored by the blood in the wounds and also by the wound secretion.

After the propagation of the tetanus bacillus has commenced, the elimination of the highly poisonous toxin also takes place and progresses rapidly. The tetanus bacillus does not enter the general tissues of the body, but remains at the point of entrance (wounds), and exerts its destructive effects only through the action of the toxins which it eliminates.

The toxins are conveyed along the nerve channels to the central nervous system, where they exert their pathogenic action on the motor nerve cells. The central nervous system, and especially the spinal cord, are first affected by the toxin, and all functional manifestations of the intoxication, as well as the increased reflex irritability, such as the tonic spasms of the muscles, are the results of the poisoning of the nerve cells of the spinal cord.

The mode of action of the tetanus toxin is explained by Ehrlich's side-chain theory in the following way: Every toxin molecule consists of a nonpoisonous (haptophore) and a poisonous (toxophore) atom group. On the other hand, the protoplasm of the motor nerve cells consists of a vital nucleus and of numerous side chains (receptors), of which some possess a special affinity toward the haptophore atom groups of the toxin molecules. If molecules of the tetanus poison enter the nerve cells, they become anchored to the corresponding receptors of the cell protoplasm by the haptophore atom group, and their toxophore group exerts a harmful effect on the vital nucleus of the cell. There follows either a total destruction of the cell protoplasm as a result of this combination or a stimulation of the cell protoplasm to defensive action, which is manifested by the continual production and elimination of the receptors into the blood. The presence of these free receptors in the blood of immunized animals explains the antitoxic immunity, since these receptors are enabled to combine with the haptophore atom of the toxin molecule before it has had an opportunity to attack the cell protoplasm.

The tetanus toxin, according to Ehrlich, contains at least two poisons, the tetano-lysin and the tetano-spasmin. He showed that on the relative proportions of these poisons depends whether the toxin has stronger tetanic properties and a weaker hemolytic action, or vice versa.

The slow progress of conducting the toxin from the peripheral nerve endings to the central nervous system explains the relatively long period of incubation in the disease.

## IMMUNIZATION.

After the successful demonstration of the highly poisonous action of the tetanus toxin, and the possibility of its neutralization by tetanus antitoxin, Von Behring and Kitasato succeeded in establishing a practical method of immunization against tetanus in both man and animals.

Ever since the discovery of the tetanus antitoxin its use as a preventive has been recommended. The statistics which were collected from its application for such purposes established its effectiveness beyond any doubt. In human medicine it has given splendid results, and the data regarding its protective action in veterinary medicine are also very convincing. As a matter of fact, the use of tetanus antitoxin in veterinary medicine has some advantages over its value as a protective agent in human medicine, since it has been definitely established that the antitoxins in a serum of a certain species is retained for a longer time when injected into the body of the same species than when administered into a different species. Accordingly, tetanus antitoxin, which is prepared in the serum of horses, has a much longer prophylatic action for horses than it has for any other species of animals.

Nocard, who was the first to recommend the use of tetanus antitoxin for horses, showed in his statistics that out of 2,727 horses which, after various operations, were treated with tetanus antitoxin, not a single case of tetanus developed, while during the same period 259 cases of tetanus developed in horses under similar conditions which were not given antitoxin injections. Numerous other statistical data could be cited to illustrate the value of tetanus antitoxin as a prophylactic for horses. Therefore it should be employed as a preventive in all instances when there is the slightest danger of tetanus developing in animals subsequent to injuries or operations.

## THE STANDARDIZATION OF ANTITOXIN.

While in the chemical sense we have no knowledge of the composition of tetanus toxin and antitoxin, nevertheless, in test-tube experiments, by mixing the toxin with the antitoxin in certain proportions a complete neutralization of the substances may be accomplished, which can be proven by inoculation into test animals.

In consideration of this fact, and owing to the increasing use of the tetanus antitoxin in practice, it became necessary to establish a definite standard by which some uniformity in the product could be obtained for therapeutic purposes. The method of standardization

varies in the different countries, and in the United States an antitoxin unit has been established by Rosenau and Anderson[1] which is 10 times the least amount of serum necessary to save the life of a 350-gram guinea pig for 96 hours against the official test dose of the standard toxin.

This standard has been accepted by the United States Public Health and Marine-Hospital Service, but veterinary antitoxin was not subject to this method of standardization, and it did not become standardized until the necessity for a uniform standard of this veterinary product was pointed out by the present writers in a previous publication on "The Need of Controlling and Standardizing the Manufacture of Veterinary Tetanus Antitoxin."[2] In this bulletin the authors described the results of the standardization of the various veterinary tetanus antitoxins prepared by different manufacturers. These tests were undertaken to ascertain whether this valuable biological product prepared by the different firms was of a uniform potency. The results of these investigations showed that a great variation existed in the products of the various companies, and accordingly the necessity was pointed out for a uniform standard in the different veterinary tetanus antitoxins in order that this product could be utilized with satisfactory and reliable results. In these experiments the standard was fixed at 1,500 immunity units, which is the standard established and approved by the United States Public Health and Marine-Hospital Service. It was not the intention to prove at that time that it would absolutely require 1,500 units to prevent the development of tetanus from an infection, but this amount was taken as a relative quantity which was then and is at present uniformly employed in human practice for preventive purposes. As a direct result of that investigation, firms which had previously placed irregular volumetric quantities of fluid in their syringes and which had been using a standard by which the veterinary product of weaker potency was labeled more than 300 times higher in units than the really stronger product for human use, were led to accept the standard recommended by the United States Public Health and Marine-Hospital Service, and as a consequence our subsequent tests of these various antitoxins have shown a pleasing uniformity in the antitoxic potency of all these products. While previous to this publication only one of the manufacturers stated on the label the number of American units contained in his veterinary antitoxin, now all these products are marked with the number of American units, and as a result the practitioner not only has more confidence in their potency, but he is accurately guided in the dose by the statement on the label.

[1] United States Public Health and Marine-Hospital Service, Hygienic Laboratory, Bulletin 43.

[2] Bureau of Animal Industry, Bulletin 121

## IMMUNIZATION TESTS.

While the determination of the smallest amount of tetanus antitoxin required for preventive purposes would be difficult in human medicine, this may be more readily ascertained for veterinary purposes. For this disease the following experiments were undertaken with the view of establishing the smallest number of units which would be necessary to protect a susceptible horse against a fatal infection with tetanus.

The tetanus bacilli were grown in glucose bouillon. Gill's pattern flasks of 500–550 cubic centimeters capacity were filled with the medium and inoculated with the tetanus bacillus. The surface was covered with paraffin and the flasks were incubated. In the course of about 2 or 3 weeks the flasks contained a rich sediment, the examination of which showed that about 60 to 70 per cent of spores were contained in the culture.

Before undertaking the tests on the horses, guinea pigs were inoculated with the pure culture containing the toxin. These guinea pigs of course died within the ordinary time with typical symptoms of tetanus. Other guinea pigs were inoculated either with cultures whose toxins were destroyed by heating at 75° C. for 45 minutes or with cultures from which the toxins were eliminated by repeated washing and filtering through a Chamberland filter. The bacilli and spores retained in the filter were then removed by rinsing out the bougie, and this suspension was employed for the inoculations. In this test it was found that guinea pigs which had been inoculated in this manner, either subcutaneously or intramuscularly, failed to develop the disease. On the other hand, if the culture had been mixed with sterilized dirt or fine sand, the disease invariably developed in the animals, and, depending upon the quantity injected, death from typical tetanus ensued in from 2 to 5 days. In the preliminary experiments it was observed that bruising or lacerating the skin previous to the injection favored the development of the disease.

It was found that for the guinea-pig inoculations one-fourth to one-half cubic centimeter of washed tetanus cultures (freed from the toxin), mixed with a very small quantity of sterilized dirt, was sufficient to produce the disease.

After these preliminary experiments had established the requirements for a fatal infection, the experiments proper were undertaken on horses.

In all, eight horses were used in this investigation. In selecting the animals it was aimed to obtain more or less uniformity in size and age. They were taken to the Bureau Experiment Station at Bethesda, Md., and kept there for several weeks before the experiments were undertaken. All animals were in good health and fair condition and gradually gained in weight previous to the tests.

In inoculating the horses with virulent material it was aimed to have the methods of infection conform as nearly as possible to those occurring under natural conditions. Preliminary to infection the place of inoculation was bruised either by a severe blow with a blunt instrument or by pinching the parts. This was attempted in order to afford the spores a favorable medium for germination. The materials used for inoculation of the horses were cultures heated to 75° C. for 45 minutes in order to eliminate the toxin. Three cubic centimeters of such culture, to which a small quantity of sterilized dirt was added, was injected into each of the animals in the experiment.

Following the injection of the virus the various horses received different quantities of antitoxin at different times subsequent to the infection. In all instances the injections of antitoxin were made in the left side of the neck. One of the horses received only the virus and served as a check on the experiment. The results obtained were as follows:

No. 1, bay gelding, used as a control animal, received an intramuscular inoculation on the right shoulder on August 2, 1911. On August 9 localized tetanus was noticed in the right forelegs. August 10, generalized tetanus developed with complete trismus and also opisthotonos. The muscles of the neck, chest, loins, and limbs showed tonic spasms and were very tense. August 11, died of tetanus.

No. 2, bay mare, inoculated August 2 subcutaneously in the right front foot slightly above the heel. This animal received 300 units of antitoxin 48 hours subsequent to the infection. Careful observation failed to reveal at any time any indications of tetanus.

No. 3, bay gelding, inoculated August 2 intramuscularly in the croup with the same quantity of culture as previously mentioned. This animal, 72 hours after infection, received 500 units of antitoxin. No symptoms of tetanus developed as a result of the exposure.

No. 4, bay gelding, inoculated August 2 intramuscularly in the right shoulder. Forty-eight hours later 250 units of antitoxin were injected. On August 11 this animal developed well-pronounced localized tetanus in the right foreleg. August 12 the spasms extended to the muscles of the shoulder and neck. The disease showed no further progress, and from August 15 the symptoms gradually diminished in severity and the animal recovered without any treatment.

No. 5, black gelding, inoculated August 2 subcutaneously in the right side of the withers. Ninety-six hours after infection 400 units of antitoxin were injected. On August 12 slight tetanic spasms developed in the muscles of the right foreleg and shoulder, but these symptoms gradually disappeared without interference.

No. 6, brown gelding, inoculated August 2 intramuscularly in the biceps muscle of the right leg with the usual quantity of tetanus virus. Ninety-six hours after the infection 700 units of antitoxin were injected. No symptoms whatsoever developed subsequently.

No. 7, bay gelding, inoculated August 2 subcutaneously in the scrotum. Sixty-eight hours later 600 units of antitoxin were injected. This animal showed no indication whatsoever of tetanus.

No. 8, black stallion, inoculated August 2 intramuscularly on the right side of the neck. Seventy-two hours after the infection 500 units of antitoxin were injected. This animal also failed to develop any symptoms of tetanus.

From the above-cited cases it is evident that a considerably smaller dosage of antitoxin could be employed for preventive purposes in horses than has been recommended for man. Only in two instances (horses Nos. 4 and 5) did localized tetanus develop subsequently to the antitoxin injection, and even these animals recovered. In these cases 250 and 400 units of antitoxin were injected, respectively.

In consideration of the fact that all the horses used in these tests were quite aged and accordingly not nearly so susceptible as young animals, a somewhat larger amount of antitoxin would be necessary to prevent absolutely the development of tetanus in the latter class of animals. Accordingly 500 units would seem to be sufficient for the prevention of tetanus in horses of any age. Since the cost of this product could be reduced considerably by employing this smaller quantity of antitoxin as compared with the former preventive dose of 1,500 units, its application in practice will probably become more general when the standard of 500 units is adopted.

It will be observed that in these experiments the antitoxin was employed at different periods subsequent to the infection, and the results obtained indicate that the administration of the antitoxin even 96 hours after the infection will prevent the development of the disease. This is of considerable practical importance, inasmuch as frequently the veterinarian is called to attend an injured animal only after a considerable time has elapsed following the injury.

Dr. A. P. Hitchens,[1] who carried out similar experiments on horses, failed to notice the development of any symptom of the disease in the animals receiving more than 100 units. While the neutralization of the developing toxin may take place from such small quantities of antitoxin if injected early enough after the infection, where the antitoxin is injected after a longer period than one day following the infection it would not be entirely safe to use such a small dosage of antitoxin.

From the results of these investigations it may therefore be concluded that 500 American units is a sufficient dose of antitoxin for use as a prophylactic, even in cases where the infection has occurred four days prior to the injection of antitoxin.

## THE CURATIVE ACTION OF TETANUS ANTITOXIN.

While there is no longer any doubt that the preventive action of tetanus antitoxin is highly reliable and its use recommendable in all instances where there is the slightest danger of infection, the curative action of the antitoxin is not very satisfactory. The failure from this mode of treatment can not be attributed to the ineffectiveness of the tetanus antitoxin to neutralize the toxins, but to the fact

[1] American Veterinary Review, vol. 37, p. 597.

that the tetanus toxin has already saturated the system and has been anchored by the protoplasm of the nerve cells. In applying the tetanus antitoxin for curative purposes the continuous formation of the tetanus toxin is neutralized, but the damage already accomplished by the previously eliminated toxin is such that beneficial results are by no means certain from the injected antitoxin. Nevertheless, if the antitoxin is injected in the earliest stages of the disease, when it has not yet progressed beyond hope of recovery and the newly developed toxin is neutralized by the antitoxin, good results may be obtained from the antitoxin.

As a whole, the results obtained with the antitoxin treatment in tetanus after symptoms have developed are not very satisfactory, judging from the extensive statistics which have been collected. However, it appears that the results are at least encouraging. Of course it is always advisable to use very large amounts of antitoxin, and probably more recoveries could be expected by the antitoxin treatment if the antitoxin were used more liberally. The curative dose was considered for a time to be about twice the amount of the immunizing dose. This, however, proved by far too small, and in many instances it would require 20 times the quantity of the prophylactic dose to obtain the desired results as a curative agent.

In the treatment of tetanus with antitoxin, its cause, of course, should also come into consideration, and the point of infection should be located, if possible, in order that it may be thoroughly cleansed and disinfected. The employment of 30,000 to 40,000 units of antitoxin in the treatment of a single case of tetanus in a horse would discourage a good many owners and practitioners from its use, especially if in one or two cases the results were not satisfactory even after the administration of these large doses.

In the French army the mortality of horses from tetanus was reduced from 72.7 to 57 per cent after the use of antitoxin as a curative agent. The results in the Prussian army also are quite similar, and there has been a considerable reduction in the percentage of mortality since the treatment by antitoxin. The reports of some practitioners are also very encouraging, although in many cases where favorable results have been obtained great quantities of antitoxin have been used. Thus, Knoor reports that in his treatment of tetanus the cost of the antitoxin for a single horse amounted to $50.

### MAGNESIUM SULPHATE TREATMENT OF TETANUS.

The experiments of Meltzer and Auer [1] on the effects of the intraspinal injection of magnesium salts upon tetanus showed that such injections have a very favorable effect upon the tetanic spasms both

[1] Studies from the Rockefeller Institute for Medical Research, vol. 6, 1907.

on experimental animals and man. The results of their work are summed up in the following conclusions:

Intraspinal injections of magnesium sulphate, in doses which do not affect the respiratory center or other vital function, are capable of abolishing completely all clonic convulsions and tonic contractions in cases of human tetanus, and experimental tetanus in monkeys. The relaxing effects of the injections may last 24 hours or longer.

In experimental tetanus in monkeys early intraspinal injections of magnesium salts are capable of retarding the progress and development of the tetanic symptoms.

Encouraged by these results, the magnesium sulphate treatment has also been employed by veterinarians on horses affected with tetanus, and in a number of recorded instances very good results were obtained from this treatment alone, or when associated with the use of antitoxin. Thus Dawson [1] obtained good results in tetanus of horses from such treatment. Dykins [2] likewise reported recoveries in animals (one case was a heifer) from subcutaneous injection of magnesium sulphate.

In 1911 the authors had an opportunity to apply this treatment to a horse which was used for hyperimmunization work with swamp fever and was considered from this viewpoint as an extremely valuable animal. This horse developed a rapidly progressing attack of tetanus, and shortly after it was reported from the Bureau Experiment Station the treatment with subcutaneous injections of a saturated solution of magnesium sulphate was begun. It was the intention to begin treatment with several very large doses of tetanus antitoxin, in order to bind any toxin which had not previously combined with the protoplasm of the nerve cells, and to continue the treatment with the magnesium sulphate solution; but as a sufficient quantity of antitoxin was not immediately available, and since a marked reduction in the tonic spasms of the muscles was apparent even after the first few injections of magnesium sulphate, the latter treatment alone was employed. However, it is our opinion that the combined method of treatment would be preferable. The condition of the animal prior to the treatment was typical of a generalized well-developed case of tetanus. Trismus and opisthotonos were present. The posture was rigid, the head extended, and the tail elevated. The nostrils were extremely dilated, and the protrusion of the membrana nictitans over the eyeball was particularly in evidence. The muscles were very tense and tonic spasms of the various groups of muscles could be observed. The respiration and the pulse were markedly accelerated, but the temperature was practically normal. Twenty cubic centimeters of the solution was injected on each side of the neck twice

[1] The Journal of Comparative Pathology and Therapeutics, vol. 24, 1911

[2] Veterinarian Record, No. 1213, 1911, p. 218.

daily (i. e., 40 cubic centimeters at each injection), and while for the first 4 days there was no marked change, if any, in the condition of the animal, a slight diminishing of the severity of the spasms was observed on the fifth day. In the following days the symptoms became gradually modified in severity, the opisthotonos disappeared, excitement was reduced, trismus was less pronounced, and the animal was better able to partake of some food. The treatment was continued twice daily from September 27 to October 8, and then once daily from October 9 to October 19, with the result that complete recovery took place. In about 1½ hours after each of the early injections the animal would show marked relaxation of the muscles, which seemed to indicate that the sulphate reduces the tonic spasms of the muscles rather than actually neutralizing the toxin. In this manner the animal is given an opportunity to form its own antitoxin, while its strength is being supported by the reduction of excitability and the ability to take some nourishment.

In consideration of the severity of this case and the splendid results obtained from the treatment with magnesium sulphate, the more extensive application of this treatment would be advisable, in order to obtain further data from the results of a large number of cases.

# BIOCHEMIC REACTIONS AND THE BACTERIAL COUNT OF MILK.[1]

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## INTRODUCTION.

The bacterial count as a test in milk examinations is usually applied in this country for the determination of the hygienic condition of this food. The quantitative determination of bacteria has the following advantages: It gives a mathematical figure of the cleanliness of the methods employed, temperature, and age of the milk, by demonstrating the approximate number of bacteria in a milk sample sent to the laboratory. The bacteriological control of milk affords an opportunity to exclude the milk of diseased cows in demonstrating the different pathogenic microorganisms, in so far as they belong to the group of the visible and cultivable ones; particularly, cows affected with garget can be detected. With a bacteriological count as a guide it is comparatively easy to determine the cause of uncleanliness and to institute proper means of correcting it. A standard for the bacteriological content of milk for city supply can therefore be established.

There are, however, certain distinct limitations or disadvantages to the bacteriological examination of milk: (1) The long time required to obtain results; (2) the qualitative determination of the bacterial types or species is too complex, and not advisable as a routine procedure; (3) contrary to existing ideas of many health officers, the controlling methods are not very easy and need the help of one skilled in bacteriological technique; (4) the bacterial count reveals to the consumer the hygienic condition of the milk, but does not give the dairyman or the inspecting veterinarian assistance at the site of production. The hygienic condition of milk secreted by a diseased cow may appear to be good from the bacterial count, but proves to be dangerous for infant feeding. Such harmful substances eliminated with the milk can be demonstrated only by means of enzym reactions and not by the quantitative bacterial test.

It has therefore been the aim of the writer to compare some of the enzym reactions with the bacterial count and to determine if it was

[1] The work reported in this paper was done in cooperation with the Pennsylvania State Live Stock Sanitary Board.

possible to obtain the information derived from the bacterial count by the shorter and easier methods. The publications of Mogendorff, Jensen, and others have proved the value of the following tests: (1) The catalase test; (2) the acid test; (3) the reductase test; (4) the fermentation test; (5) the alcohol test; (6) the temperature of the milk. All of these tests will be discussed separately.

## THE CATALASE TEST.

### LITERATURE.[1]

In the year 1901 Oscar Loew found an enzym which had the property of separating hydrogen peroxid into water and oxygen. He called this enzym catalase. This enzym is at the present time also called superoxydases (Raudnitz) and peroxydases (Limossier).

Babcock and Russell were of the opinion that all enzyms are catalytic. Babcock first demonstrated that blood serum contains catalase. Loew demonstrated by careful experimentation that many microorganisms are producers of catalase; for example, the bacillus prodigiosis. He also found that catalase has the property of oxidizing many chemical compounds, and that it is destroyed at a temperature of from 72 to 75° C. A solution of 1 per cent sodium hydroxid or a 1 per cent mineral acid solution will instantly destroy this enzym. Catalase is insoluble in absolute alcohol, is slightly soluble in 50 per cent alcohol, and is rapidly destroyed in a weak solution. According to Loew, catalase should be considered an oxidizing enzym. He used the iodometric methods for this determination.

In 1903 Jolles demonstrated by using a modified form of the A. Bertrand method that human milk had the property of reducing hydrogen peroxid. Shortly following this, Raudnitz demonstrated the presence of catalase in milk. Fridung and Hecht showed by a series of experiments with the catalasometer that cream has far more catalytic properties than skimmed milk. Palazzi conducted a similar series of experiments showing that the upper layers of milk contain more catalase than the lower.

The publications of Konig were fundamental and brought before the experts the fact that a more detailed research was necessary. Some of his investigations and ideas are as follows: He demonstrated catalase by means of a fermentation method. Oxygen is only liberated from hydrogen peroxid in from 10 to 20 minutes. He also estimated the amount of catalase in milk by means of the oxygen separated from a definite amount of hydrogen peroxid. He states that when hydrogen peroxid is mixed with a given volume of milk and kept at a temperature of from 20 to 25° C., the reaction may be determined after 2 hours and usually continues to increase slightly

[1] References to the principal papers referred to in this article will be found at the end of the article.

for 24 hours. The strength of the peroxid solution is of importance, and he proved the 1 per cent solution to be the best. In his last publication [1] he compared the catalytic activity with the Trommsdorff test for leucocytes and came to the conclusion that if an overwhelming number of bacteria are present a bacterial infection of the udder exists and the catalase is in the main due to bacteria.

The following microorganisms were found by Konig to produce catalase.

| Microorganisms. | Diastase. | Reductase. | Catalase. |
|---|---|---|---|
| | | *Minutes.* | |
| *Bacillus proteus* Zopfii | s | 15 | 5½ |
| *mesentericus* | s | 60 | 30 |
| *subtilis* | s | 40 | 17 |
| *mycoides* | 0 | 90 | 11 |
| Milchbakterie I | 0 | 80 | 55 |
| Milchbakterie II | ss | 90 | 15 |
| *Bacilus fluorescens*, nonliquefying | s | 15 | 29 |
| liquefying | s | 13 | 53 |
| Stall-Luftbakterie I | 0 | 90 | 28 |
| Stall-Luftbakterie II | 0 | 90 | 31 |
| *Bacillus acidi lactici* Hueppe | 0 | 12 | 32 |
| *coli communis* | 0 | 17 | 39 |
| *prodigiosus* | ss | 15 | 58 |
| *acidi paralactici* | 0 | 90 | 0 |
| *Streptococcus acidi lactici* Grot | 0 | 90 | 0 |
| *mastitidis* longus | 0 | 55 | 0 |
| brevis | 0 | 90 | 0 |
| Milchsaurebakterien Zoffmann | 0 | 90 | 0 |
| Hansen | 0 | 90 | 0 |
| *Oidium lactis* | 0 | 90 | 11 |

The optimum temperature for the production of catalase in milk is 37° C. The blood contains catalase in large quantities; urine also contains catalase. Milk heated for half an hour loses its catalytic activity; heated to 65 to 70° C. for half an hour the entire catalase disappears. Konig drew the following deductions:

That the catalytic action of milk can be determined by iodometric and gasometric methods. The iodometric method of Jolles is incorrect, as it measures too high a percentage of catalase. The fat and cream of raw milk contain more catalase than skimmed milk. Normal, raw, fresh milk contains a uniform absolute quantity of catalase. One hundred grams of normal, raw, fresh milk separated in 2 hours about 110 mg. of hydrogen peroxid. The bacteria usually found in milk produce catalase by their metabolism. Bacteria in the second place are the cause of the catalase increasing with the age of the milk. In pathological processes of the udder the quantity of catalase in milk is increased. Mastitis bacteria inoculated into sterile milk produce no catalase. The mastitis bacteria change the metabolism of the secreting cells. Probably a part of the catalase in milk from a diseased udder originates from the blood. The milk catalase and the bacteria catalase are weakened to a certain extent in passing through a Chamberland-Pasteur filter. Leucocytes increase the quantity of catalase in milk. The age of milk may be partially determined by estimating the amount of catalase.

[1] Milchwirtschaftliches Zentralblatt, vol. 7, p. 12. Leipsic, 1911.

Following Konig, many investigators were engaged in the study of catalase in milk, but only the publications relating to catalase in milk, when compared to the bacterial count, will be mentioned.

E. Seligmann found that lactic acid exerts a paralytic effect on the production of catalase. When the milk is so sour as to be visibly curdled it has a retarding influence upon the production of catalase. E. Huymen confirmed this observation in sour milk; therefore the amount of oxygen can not be taken as a measure of the amount of catalase present in milk in this condition. E. Seligmann emphasizes particularly the sources of catalase in milk, and mentions as such, leucocytes, bacteria, original ferments, inflammatory products, etc., and states that milk containing lactic-acid-producing bacteria does not produce any catalase. Milk containing a moderately high content of catalase is usually inclined to sour. His first observations will be discussed in detail later.

FIG. 3.—Gerber's apparatus used for determining gas produced by catalase fermentation in milk.

Gerber, Loebeck, and Ottiker regard the method of Konig as defective, and have invented an apparatus known as the catalasometer. (See fig. 3.) This apparatus consists of a bottle for holding the hydrogen peroxid and milk, and a tube, called a volumeter, for collecting and measuring the oxygen. If the volumeter is not properly attached there may be an escape of some of the oxygen, which would cause a false reading. The inventors describe the use of their apparatus as follows:

In the Gerber-Loebeck method 3 c. c. of a 1 per cent solution of hydrogen peroxid and 9 c. c. of milk are used. After they have been placed in the bottle, the rubber stopper is inserted down to the opening in the neck; the volumeter is then placed into

the perforation in the stopper, and the latter is forced down sufficiently to close the opening in the neck of the bottle. There should be no air bubbles in the water. The fluid in the bottle should be thoroughly mixed by shaking. The bottles are made sufficiently large to permit this without any of the mixture being deposited on the stopper. The apparatus is then placed in a water bath at from 20 to 25° C., only the bottle being placed in the water, and the rubber stopper in the top of the volumeter is removed to avoid any counter pressure against the forcing of the water from the middle chamber and the outer by the oxygen, which will be separated. After 2 hours the amount of oxygen collected in the volumeter is observed. Some of the oxygen may remain in the mixture in the bottle or adhere to the walls in small bubbles if the mixture is not shaken and the shaking continued until the amount of oxygen in the volumeter remains constant; a difference of 0.3 to 1 c. c. from this cause has been observed. Since many bacteria can produce catalase, it is necessary that the bottles, rubber stoppers, and pipettes be well cleaned and sterilized for at least 15 minutes in boiling water. Water containing milk salts should be avoided, as, according to J. Meyer, pumice stone, kaolin, and platinum added to boiled milk have a tendency to separate the oxygen from the hydrogen peroxid. Boiled distilled water should therefore be used for the filling and cleaning of the pipettes which are needed for the measuring and collecting of samples.

It has been pointed out by Konig and supported by Gerber that the catalase contained in milk is influenced by the amount of hydrogen peroxid present. It is therefore of importance that the solution of hydrogen peroxid should always be of the same strength, and it is necessary to standardize the solution by titration with one-tenth normal solution of permanganate of potassium and dilute sulphuric acid. The preparation, the titration, and the standardization of the 1 per cent of hydrogen peroxid is carried out as follows:

The solutions necessary for standardizing the 1 per cent of hydrogen peroxid are the dilute solution of sulphuric acid and the one-tenth normal potassium permanganate. The dilute sulphuric acid is made by adding 100 c. c. of sulphuric acid with a specific gravity of 1.82 to 400 c. c. of distilled water. Ten cubic centimeters of a supposedly 1 per cent solution of hydrogen peroxid is placed in a beaker with 90 c. c. of distilled water and thoroughly mixed. Ten cubic centimeters of this solution is placed in another beaker with 10 c. c. of the dilute sulphuric acid and thoroughly mixed. The tenth normal potassium permanganate is gradually added from a burette until the solution in the beaker turns a light violet color. Suppose it required 6 c. c. of the tenth normal potassium permanganate to produce a violet color, then $6 \times 0.0017008 = 0.0102048 \times 100 = 1.02$ per cent. The factor 0.0102048 equals the amount of hydrogen peroxid that 1 c. c. of a tenth normal solution of potassium permanganate will neutralize.

Milk from one or several cows in normal condition, tested by the Gerber-Loebeck method immediately after being drawn, will always show less than 3 c. c. of oxygen at the second hour of the test, and not over 4 c. c. later.

Milk obtained in the market, if fresh, from normal cows, and which has been cooled and properly handled, will not show over 4 c. c. at the second to the sixth hour of the test.

The conclusions of Gerber and Loebeck concerning catalase are as follows:

Fresh, cool, properly handled milk of healthy cows should never show, after 2 to 6 hours, catalase of more than 4 c. c. A similar condition is to be demanded of old milk from healthy cows. Should a higher percentage of catalase be observed, then there is a suspicion that such milk originated from diseased or badly handled cows. Such milk samples contain large numbers of bacteria, and have then to be examined bacteriologically. In a gas production of 2.5 c. c. or 3 c. c. it is not necessary to institute a stable inspection or an individual examination of the cows. They emphasize the

necessity of uniformity in registering the results, and explain how valuable a simple catalase test is in conjunction with other tests for the public health officials, farmers, dairymen, and families.

The details of their investigations will be discussed in connection with the present author's observations.

## THE ORIGIN OF CATALASE.

Catalase can be precipitated with the casein and is attached to the fat globules. O. Jensen thought, therefore, that the catalase was an endo-ferment.

Grimmer showed that catalase is a secreted enzym, and is therefore extracellular.

Faitelowitz found a large number of microorganisms which produce catalase. He also found that hydrogen sulphid, potassium cyanid, hydrochloric acid, sulphuric acid, nitric acid, acetic acid, oxalic acid, potassium chlorate, mercuric cyanid, and barium nitrate act as ferment poisons.

Kooper states that breeding undoubtedly has an influence on the catalase. (Hewlett found that Danish cattle gave more catalase than English.) Cows from Breidenberg had more catalase in their milk than cows from Friedland. The quantity of catalase varies also in different normal cows of the same breed. Only a small portion of catalase present in milk comes from the udder, the larger amount being due to the presence of microbes. In unclean milk catalase is produced quicker and more abundantly than in clean milk. In certain instances there will be a difference in the amount of catalase in milk drawn at different intervals. The amount of catalase increases during the milking period, there being more in the last milk than in the first; but milk containing a high percentage of fat does not necessarily contain a large amount of catalase. Milk heated gives a higher catalytic activity when infected with bacteria than unheated milk treated in a similar manner.

Huynen considered the catalase reaction of the utmost importance. Its application is simple, and the results correspond with those obtained by other methods. Mastitis can be detected, presumably in its early stages, even though no alterations of the gland or visible indications in the milk are to be found.

Mogendorff has, in a large series of very complete experiments, determined the physiological and pathological condition of the cow, which increases the catalase in milk. (In the manufacture of cheese the catalase is precipitated with the casein.) The main ideas of his work are given in the following lines:

Colostrum milk is rich in catalase. Cows in heat sometimes give an abnormal amount of catalase. Certain or pronounced changes in feed increase the catalase in milk. Incomplete milking of cows also increases the catalase, because it increases the

number of leucocytes in the secretion. Cows in the last stages of lactation give a high catalase content. Their glandular tissue is more permeable for the blood salts and the blood catalase, as well as for the leucocytes. In pathological milk different causes may be ascribed to the variation of the catalase. Every abnormal irritation of the glandular tissue of the udder increases the amount of catalase in the milk. The milk of cows affected with mastitis is very rich in catalase (excepting in garget). The chemical irritation of the gland cells by the toxins of microorganisms causes an increased transition of blood catalase, and by necrosis of the secreting cells an increase of catalase in the milk. That the leucocytes in such inflammatory processes increase the catalase is self-explanatory. As the udder is also an organ of excretion, metabolic products, due to pathological processes in the body, may become eliminated by the glandular tissue of the udder and increase the catalytic activity of the milk. It may be mentioned here that clinical symptoms may be absent, and by means of the catalase test such pathological processes in the body may be detected. High fever undoubtedly increases the catalytic substance in milk. It is not the intention of this paper to mention all the diseases which may influence the catalase, but inflammatory processes of the uterus, multiple abscess formation in the lungs, pericarditis, panaritium, extensive or generalized tuberculosis, kidney diseases, disturbance in the digestive apparatus, etc., all have an influence on its production. In the discovery of cows affected with mastitis, the catalase test was found to be much more satisfactory than the usual clinical methods of examination. In traumatic, streptococcic, and colimastitis, the catalase is increased. For this test Mogendorff used milk samples which were preserved with a 1 per cent solution of boric acid.

## THE AUTHOR'S EXPERIMENTS AND OBSERVATIONS CONCERNING CATALASE.

### APPARATUS AND TECHNIQUE.

In the present author's experiments Gerber's apparatus (fig. 3) was used for the catalase in estimating the number of cubic centimeters of gas produced in 2 hours. The standard of this method is that normal milk should not produce over 4 cubic centimeters of gas in 2 hours. The cork in the top of the chamber marked *A* was removed and distilled water added until it rose up to the mark "2" on the graduated volumeter. The cork was then placed in position, and this part of the apparatus set aside. Nine cubic centimeters of the sample of milk was placed in a small bottle with 3 cubic centimeters of a 1 per cent solution of hydrogen peroxid, which had been standardized with the potassium permanganate solution, as previously described. The top chamber was then immediately attached to the bottle containing the milk and hydrogen peroxid. The cork was then removed from the top chamber *A* and the entire apparatus set aside at room temperature for 2 hours. At the expiration of this time the scale was observed, to note how many cubic centimeters of oxygen had been liberated by the catalase ferment.

### CATALASE AND ALCOHOL TESTS OF INDIVIDUAL COWS.

The catalase and alcohol[1] tests were applied to individual cows' milk at various intervals after milking, also to milk drawn at different

[1] The technique of the alcohol test is described on page 216.

periods of the day. Where the milk was tested at different intervals after milking it was kept in the refrigerator at 15° C. In the two animals to which the tests were applied, Nos. 36 and 56, there was no particular difference in the amount of catalase produced at different intervals just after the milk was drawn. There was, however, a considerable difference in the amount of catalase where the milk was drawn at different times of the day. In both instances there seemed to be a larger amount of catalase produced during the middle of the day. The results are shown in the following table:

*Results of catalase and alcohol tests applied to milk of individual cows at various intervals after milking.*

| Cow No. | Time of drawing milk. | Time of applying tests. | Catalase test—gas produced in 2 hours. | Alcohol test. |
|---|---|---|---|---|
| | | | *C. c.* | |
| 36 | 8 a. m., Feb. 15, 1911 | At once | 2.5 | Negative. |
| | | 2 hours | 3.3 | Do. |
| | | 4 hours | 3.0 | Do. |
| | | 6 hours | 2.4 | Do. |
| | | 8 hours | 3.0 | Do. |
| | | 12 hours | 1.5 | Do. |
| | | 30 hours | 2.5 | Do. |
| 36 | 5 p. m. | At once | 5.2 | Positive. |
| | | 16 hours | 6.5 | Do. |
| | | 18 hours | 6.5 | Do. |
| | | 24 hours | 7.0 | Do. |
| 36 | 8 a. m., Feb. 27, 1911 | At once | 2.4 | Do. |
| | | 2 hours | 1.5 | Do. |
| | | 6 hours | 2.4 | Do. |
| | | 8 hours | 2.8 | Do. |
| | | 12 hours | 1.8 | Do. |
| | | 24 hours | 1.8 | Do. |
| | | 30 hours | 2.0 | Do. |
| 56 | 8 a. m., Feb. 17, 1911 | At once | 3.6 | Negative. |
| | | 2 hours | 3.8 | Do. |
| | | 4 hours | 4.0 | Do. |
| | | 6 hours | 3.4 | Do. |
| | | 8 hours | 3.0 | Do. |
| | | 12 hours | 2.5 | Do. |
| | | 24 hours | 3.5 | Do. |
| 56 | 8 a. m., Feb. 21, 1911 | At once | 1.5 | Do. |
| | | 3 hours | 4.2 | Do. |
| | | 6 hours | 2.0 | Do. |
| | | 8 hours | 2.4 | Do. |
| | | 9 hours | 3.0 | Do. |
| 56 | 5 p. m., Feb. 27, 1911 | At once | 4.0 | Do. |
| | | 16 hours | 3.5 | Do. |
| | | 18 hours | 3.4 | Do. |
| | | 24 hours | 3.4 | Do. |

*Results of catalase and alcohol tests applied to milk drawn at different hours.*

| Cow No. | Time of drawing milk. | Catalase test—gas produced in 2 hours. | Alcohol test. |
|---|---|---|---|
| | | *C. c.* | |
| 36 | Feb. 20, 1911: | | |
| | 8 a. m. | 3.5 | Negative. |
| | 11 a. m. | 5.5 | Do. |
| | 2 p. m. | 4.0 | Do. |
| | 4 p. m. | 1.4 | Do. |
| | 5 p. m. | 1.4 | Do. |
| 36 | Feb. 21, 1911: | | |
| | 8 a. m. | 1.2 | Do. |
| | 11 a. m. | 3.5 | Positive. |
| | 2 p. m. | 2.4 | Negative. |
| | 4 p. m. | 2.5 | Do. |
| | 5 p. m. | 2.8 | Do. |
| 56 | Feb. 20, 1911: | | |
| | 8 a. m. | 3.0 | Do. |
| | 11 a. m. | 7.0 | Do. |
| | 2 p. m. | 5.5 | Do. |
| | 4 p. m. | 3.0 | Do. |
| | 5 p. m. | 3.5 | Do. |

During the summer of 1911 a Jersey cow, No. 86, which was suffering from a bad case of gastroenteritis, was brought to the veterinary hospital. The animal was well advanced in her period of lactation and was secreting milk from only three quarters. The milk from the animal reacted strongly to the alcohol test. It was thought advisable to compare the alcohol and catalase tests at different periods of the day, for several days. The per cent of sediment and leucocytes contained in the milk by the Tromsdorff method [1] was 0.1. The number of leucocytes per field by the Stokes method [1] was 93. The number of bacteria contained in the milk per cubic centimeter was 1,840.

The following table shows the results of the alcohol and catalase tests:

*Results of catalase and alcohol tests applied to milk of cow affected with gastroenteritis, the milk being drawn and tested at certain hours for several days.*

| Date. | 9 a. m. | | 1 p. m. | | 5 p. m. | |
|---|---|---|---|---|---|---|
| | Catalase test—gas produced in 2 hours. | Alcohol test. | Catalase test—gas produced in 2 hours. | Alcohol test. | Catalase test—gas produced in 2 hours. | Alcohol test. |
| 1911. | *C. c.* | | *C. c.* | | *C. c.* | |
| Nov. 21 | 1.5 | Positive | 3.0 | Positive | 3.0 | Positive. |
| Nov. 22 | 2.0 | do | 3.0 | do | 3.0 | Do. |
| Nov. 23 | 1.5 | do | 3.0 | do | 4.0 | Do. |
| Nov. 24 | 1.5 | do | 3.0 | do | 1.5 | Do. |

[1] These methods are described in Bureau of Animal Industry Bulletin 117, pages 9 and 10.

*Results of catalase and alcohol tests applied to milk of cow affected with gastroenteritis, the milk being drawn and tested at certain hours for several days*—Continued.

| Date. | 9 a. m. | | 1 p. m. | | 5 p. m. | |
|---|---|---|---|---|---|---|
| | Catalase test—gas produced in 2 hours. | Alcohol test. | Catalase test—gas produced in 2 hours. | Alcohol test. | Catalase test—gas produced in 2 hours. | Alcohol test. |
| 1911. | *C. c.* | | *C. c.* | | *C. c.* | |
| Nov. 27 | 4.0 | Positive | 3.0 | Positive | 3.0 | Positive. |
| Nov. 28 | 2.0 | do | 2.5 | do | 3.0 | Do. |
| Nov. 29 | 2.0 | do | 3.0 | do | 3.0 | Do. |
| Dec. 1 | 3.0 | do | 3.5 | do | 3.0 | Do. |
| Dec. 5 | 2.5 | do | 3.0 | do | 3.0 | Do. |
| Dec. 6 | 2.5 | do | 3.5 | do | 3.0 | Do. |
| Dec. 7 | 3.0 | do | 3.5 | do | 3.0 | Do. |
| Dec. 8 | 2.0 | do | 3.0 | do | 3.5 | Do. |

The catalase and alcohol tests were applied over a period of 12 days. The catalase test ran rather uniform throughout the entire period, but the alcohol test gave a positive reaction in every instance. The alcohol being positive did not seem to produce an abnormal amount of catalase in this particular instance, as often occurs with other animals. This may be partially explained by the fact that no pathogenic bacteria could be found present in this sample of milk. From experiments which will be described later it was found that albumin influenced the alcohol reaction.

### THE INFLUENCE OF PRESERVATIVES ON THE PRODUCTION OF CATALASE.

It is often found expedient to preserve milk for a certain period before performing the catalase test in the laboratory. A 2 per cent solution of chloroform and 1 part of formalin to 4,000 of milk were used as preservatives. The catalase and alcohol tests were then applied at different intervals, as indicated in the following table, to note the effect on the production of catalase. In so far as the results could be interpreted, neither of the two preservatives in the strength used had any effect on the production of catalase.

*Results of catalase and alcohol tests of milk treated with certain preservatives.*

| Cow No. | Time of drawing milk. | Preservative added. | Time of applying tests. | Catalase test—gas produced in 2 hours. | Alcohol test. |
|---|---|---|---|---|---|
| | | | | *C. c.* | |
| 36 | 8 a. m., Feb. 16, 1911 | Chloroform, 2 per cent | At once | 1.5 | Negative. |
| | | | 2 hours | 3.5 | Do. |
| | | | 4 hours | 3.5 | Do. |
| | | | 6 hours | 3.0 | Do. |
| | | | 12 hours | 2.5 | Do. |
| | | | 24 hours | 2.5 | Do. |
| | | | 30 hours | 5.5 | Do. |

*Results of catalase and alcohol tests of milk treated with certain preservatives*—Continued.

| Cow No. | Time of drawing milk. | Preservative added. | Time of applying tests. | Catalase test—gas produced in 2 hours. | Alcohol test. |
|---|---|---|---|---|---|
| | | | | *C. c.* | |
| 36 | 8 a. m., Feb. 27, 1911..... | Formalin, 1 to 4,000..... | At once... | 1.4 | Positive. |
| | | | 2 hours.... | 1.6 | Do. |
| | | | 6 hours.... | 1.6 | Do. |
| | | | 8 hours.... | 1.8 | Negative. |
| | | | 12 hours... | 1.4 | Do. |
| | | | 24 hours... | 1.1 | Do. |
| | | | 30 hours... | 1.2 | Do. |
| 56 | 8 a. m..... | Chloroform, 2 per cent..... | At once... | 3.6 | Do. |
| | | | 2 hours.... | 4.0 | Do. |
| | | | 4 hours.... | 4.0 | Do. |
| | | | 6 hours.... | 4.5 | Do. |
| | | | 8 hours.... | 4.0 | Do. |
| | | | 12 hours... | 3.5 | Do. |
| | | | 24 hours... | 4.5 | Do. |

INFLUENCE OF UDDER EXTRACT ON PRODUCTION OF CATALASE.

Grimmer and Sommer proved that the glandular tissue of the udder influenced the catalase. It was thought advisable to use some of the tissue from the mammary gland to confirm the results of their investigations.

The following is a brief description of the technique used: A normal cow's udder was comminuted by passing it through an ordinary meat grinder. Twenty grams of this material was placed in a flask with 40 c. c. of sterile normal saline solution and shaken in a special apparatus for 24 hours. The extract was then diluted with 80 c. c. more of sterile normal saline solution, making in all 120 c. c. of saline solution and 20 grams of ground udder. This solution was filtered through a porcelain candle. The filtrate was plated and found to be sterile. The filtrate was then tested for the production of catalase. By using 9 c. c. of the extract and 3 c. c. of 1 per cent hydrogen peroxid it was found that no gas was produced in 2 hours.

The influence of an udder extract which had not been passed through a porcelain candle was tried in the following manner: A normal cow's udder was macerated by passing it through an ordinary meat grinder. Fifty grams of the comminuted udder and 200 c. c. of sterile physiological saline solution were allowed to stand 12 hours. Fifty grams of comminuted udder and 200 c. c. of a 10 per cent solution of glycerin were allowed to stand 12 hours. Fifty grams of comminuted udder and 200 c. c. of a 20 per cent solution of glycerin were allowed to stand 12 hours. Fifty grams of comminuted udder and 200 c. c. of a 50 per cent solution of glycerin were allowed to stand 12 hours. All of these mixtures were then filtered through sterile filter

paper and tested for the production of catalase. The following table shows the results:

*Influence of udder extract on the production of catalase.*

| No. of sample. | Description of sample. | Catalase (gas produced). | Time. |
|---|---|---|---|
| | | *C. c.* | |
| 1 | 3 c. c. saline extract+3 c. c. 1 per cent solution of hydrogen peroxid .... | 8 | 15 minutes. |
| 2 | 9 c. c. saline extract+3 c. c. 1 per cent solution of hydrogen peroxid .... | 8 | 10 minutes. |
| 3 | 9 c. c. physiological saline solution+3 c. c. 1 per cent solution of hydrogen peroxid. | 0 | 2 hours. |
| 4 | 3 c. c. 10 per cent glycerin extract+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 5 minutes. |
| 5 | 9 c. c. 10 per cent glycerin extract+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 3 minutes. |
| 6 | 9 c. c. 10 per cent glycerin solution+3 c. c. 1 per cent solution of hydrogen peroxid. | 0 | 2 hours. |
| 7 | 3 c. c. 20 per cent solution of glycerin extract+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 5 minutes. |
| 8 | 9 c. c. 20 per cent solution of glycerin extract+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 3 minutes. |
| 9 | 9 c. c. 20 per cent solution of glycerin+3 c. c. 1 per cent solution of hydrogen peroxid. | 0 | 2 hours. |
| 10 | 3 c. c. 50 per cent solution of glycerin extract+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 5 minutes. |
| 11 | 9 c. c. 50 per cent solution of glycerin extract+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 3 minutes. |
| 12 | 9 c. c. 50 per cent solution of glycerin+3 c. c. 1 per cent solution of hydrogen peroxid. | 0 | 2 hours. |
| 13 | 9 c. c. 50 per cent solution of glycerin extract filtered through kaolin +3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 3 minutes. |

The passing of an udder extract through a Pasteur porcelain candle, in the writer's experiments, removed the catalase ferment. By passing the extract through sterile filter paper it was found that the extract contained a large amount of catalase.

The statement of Grimmer, that the catalase is partially of glandular origin and secreted, can therefore be confirmed by our experiments.

### INFLUENCE OF CERTAIN BACTERIA ON THE PRODUCTION OF CATALASE.

Concerning the results of other investigators, the author also tested several different varieties of bacteria to note their influence on the production of catalase. The following is a brief description of the technique used:

Sterile bouillon was inoculated with a culture of *Bacillus prodigiosus* and allowed to incubate for 24 hours at 37° C. Sterile samples of milk were inoculated with varying amounts of the bouillon culture

to note its influence upon the production of catalase. Samples of bouillon culture without the addition of sterile milk and milk inoculated with the culture and incubated 24 hours were also used as controls on the production of catalase. The number of bacteria contained in the milk before sterilizing was 2,350 per cubic centimeter. The number of bacteria contained in one drop of the 24-hour-old bouillon culture was 896,000. The results of this experiment will be found in the following table:

*Influence of Bacillus prodigiosus on the production of catalase.*

| No. of sample. | Description of sample. | Catalase (gas produced). | Time. |
|---|---|---|---|
| | | *C. c.* | |
| 1 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+1 drop 24-hour-old bouillon culture. | ½ | 2 hours. |
| 2 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+2 drops 24-hour-old bouillon culture. | ½ | 2 hours. |
| 3 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+4 drops 24-hour-old bouillon culture. | 1.5 | 2 hours. |
| 4 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+4 drops 24-hour-old bouillon culture. | 3 | 2 hours. |
| 5 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+10 drops 24-hour-old bouillon culture. | 3 | 2 hours. |
| 6 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+12 drops 24-hour-old bouillon culture. | 4 | 2 hours. |
| 7 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+14 drops 24-hour-old bouillon culture. | 6 | 2 hours. |
| 8 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+16 drops 24-hour-old bouillon culture. | 6 | 2 hours. |
| 9 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid..... | 0 | 2 hours. |
| 10 | 1 c. c. 24-hour-old bouillon culture+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | ½ hour. |
| 11 | 9 c. c. 24-hour-old bouillon+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 15 minutes. |
| 12 | 9 c. c. sterile bouillon+3 c. c. 1 per cent solution of hydrogen peroxid.. | 0 | 2 hours. |
| 13 | 9 c. c. sterile milk inoculated with culture and incubated for 24 hours+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 1 hour. |

Sterile bouillon was incubated with a culture of *Bacillus subtilis* and allowed to incubate for 24 hours at 37° C. Sterile samples of milk were incubated with varying amounts of the bouillon culture to determine the influence upon the production of catalase. Samples of the bouillon culture without the addition of sterile milk, sterile milk, and milk inoculated with the culture and incubated for 24 hours were also used as controls on the production of catalase. The number of bacteria contained in the milk before sterilization was 2,350 per cubic centimeter. The number of bacteria contained in each drop of the 24-hour-old bouillon culture was 10,300. The results of this experiment will be found in the following table:

*Influence of Bacillus subtilis on the production of catalase.*

| No. of sample. | Description of sample. | Catalase (gas produced). | Time. |
|---|---|---|---|
| | | *C. c.* | |
| 1 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+1 drop 24-hour-old bouillon culture. | 5 | 2 hours. |
| 2 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+2 drops 24-hour-old bouillon culture. | 8 | 1½ hours. |
| 3 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+4 drops 24-hour-old bouillon culture. | 8 | 1 hour. |
| 4 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+8 drops 24-hour-old bouillon culture. | 8 | ½ hour. |
| 5 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+10 drops 24-hour-old bouillon culture. | 8 | ½ hour. |
| 6 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+12 drops 24-hour-old bouillon culture. | 8 | 15 minutes |
| 7 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+14 drops 24-hour-old bouillon culture. | 8 | 5 minutes. |
| 8 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+16 drops 24-hour-old bouillon culture. | 8 | 3 minutes. |
| 9 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid..... | 0 | 2 hours. |
| 10 | 1 c. c. bouillon culture+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | ½ hour. |
| 11 | 9 c. c. sterile bouillon+3 c. c. 1 per cent solution of hydrogen peroxid.. | 0 | 2 hours. |
| 12 | 9 c. c. sterile milk inoculated with culture and incubated for 24 hours+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | ½ hour. |

Sterile bouillon was inoculated with a culture of *Bacillus proteus* and allowed to incubate for 24 hours at 37° C. Sterile samples of milk were inoculated with varying amounts of the bouillon culture to note the influence upon the production of catalase. Samples of the bouillon culture without the addition of sterile milk, sterile milk, and milk inoculated with the culture and incubated for 24 hours were also used as controls on the production of catalase. The number of bacteria contained in the milk before sterilization was 2,350 per cubic centimeter. The number of bacteria contained in one drop of the 24-hour-old bouillon culture was 3,584,000. The results of this experiment will be found in the following table:

*Influence of Bacillus proteus on the production of catalase.*

| No. of sample. | Description of sample. | Catalase (gas produced). | Time. |
|---|---|---|---|
| | | *C. c.* | |
| 1 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+1 drop 24-hours-old bouillon culture. | 1 | 2 hours. |
| 2 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+2 drops 24-hours-old bouillon culture. | 1.5 | 2 hours. |
| 3 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+4 drops 24-hours-old bouillon culture. | 6 | 2 hours. |
| 4 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+6 drops 24-hours-old bouillon culture. | 8 | 1½ hours. |
| 5 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+10 drops 24-hours-old bouillon culture. | 8 | 40 minutes. |

*Influence of Bacillus proteus on the production of catalase*—Continued.

| No. of sample. | Description of sample. | Catalase (gas produced). | Time. |
|---|---|---|---|
| | | *C. c.* | |
| 6 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+12 drops 24-hours-old bouillon culture. | 8 | 40 minutes. |
| 7 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+14 drops 24-hours-old bouillon culture. | 8 | 20 minutes. |
| 8 | 9 c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid+16 drops 24-hours-old bouillon culture. | 8 | 20 minutes. |
| 9 | 9. c. c. sterile milk+3 c. c. 1 per cent solution of hydrogen peroxid..... | 0 | 2 hours. |
| 10 | 1 c. c. 24-hours-old bouillon culture+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 10 minutes. |
| 11 | 9 c. c. sterile bouillon+3 c. c. 1 per cent solution of hydrogen peroxid.. | 0 | 2 hours. |
| 12 | 9 c. c. sterile milk inoculated with culture and incubated for 24 hours+3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 1½ hours. |

Sterile bouillon was inoculated with culture of *Bacillus acidi lactici* and allowed to incubate for 24 hours. Sterile samples of milk were inoculated with varying amounts of the culture to determine the influence on the production of catalase. Samples of the bouillon culture without the addition of sterile milk, sterile milk, and milk inoculated with culture and incubated for 24 hours were also used as controls on the production of catalase. The number of bacteria contained in each drop of bouillon culture was 728,000. Results of these experiments will be found in the following table:

*Influence of Bacillus acidi lactici on the production of catalase.*

| No. of sample. | Description of sample. | Catalase (gas produced). | Time. |
|---|---|---|---|
| | | *C. c.* | |
| 1 | 9 c. c. sterile milk + 3 c. c. 1 per cent solution of hydrogen peroxid..... | 0 | 2 hours. |
| 2 | 9 c. c. sterile milk + 1 drop 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 0.3 | 2 hours. |
| 3 | 9 c. c. sterile milk + 3 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 0.6 | 2 hours. |
| 4 | 9 c. c. sterile milk + 6 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 1 | 2 hours. |
| 5 | 9 c. c. sterile milk + 10 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 1 | 2 hours. |
| 6 | 9 c. c. sterile milk + 15 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 2 | 2 hours. |
| 7 | 3 c. c. 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 2 | 2 hours. |

Sterile bouillon was inoculated with a culture of *Bacillus coli* and allowed to incubate for 24 hours. Sterile milk was inoculated with varying amounts of the bouillon culture to determine the influence of the production of catalase. Samples of the bouillon culture without the addition of sterile milk, sterile milk, and milk inoculated with a culture and incubated for 24 hours were also used as controls

on the production of catalase. The number of bacteria contained in one drop of bouillon culture was 1,310,000. The results of these experiments will be found in the following table:

*Influence of Bacillus coli on the production of catalase.*

| No. of sample. | Description of sample. | Catalase (gas produced). | Time. |
|---|---|---|---|
| | | *C. c.* | |
| 1 | 9 c. c. sterile milk + 3 c. c. 1 per cent solution of hydrogen peroxid..... | 0 | 2 hours. |
| 2 | 9 c. c. sterile milk + 1 drop 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 0 | 2 hours. |
| 3 | 9 c. c. sterile milk + 3 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 0.5 | 2 hours. |
| 4 | 9 c. c. sterile milk + 6 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 1 | 2 hours. |
| 5 | 9 c. c. sterile milk + 10 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 1.5 | 2 hours. |
| 6 | 9 c. c. sterile milk + 15 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 2 | 2 hours. |
| 7 | 9 c. c. sterile milk inoculated with culture and incubated for 24 hours + 3 c. c. 1 per cent solution of hydrogen peroxid. | 8 | 2 hours. |
| 8 | 9 c. c. bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid.. | 8 | 15 minutes. |

Sterile bouillon was inoculated with culture of streptococcus and allowed to incubate for 24 hours. Sterile milk was inoculated with varying amounts of the bouillon culture to determine the influence of the production of catalase. Samples of bouillon culture without the addition of sterile milk, sterile milk, and milk inoculated with a culture and incubated for 24 hours were also used as controls on the production of catalase. The number of bacteria contained in each drop of bouillon culture was 124,300. The culture of streptococcus used in this work was an organism isolated from the milk of a cow suffering from a severe case of garget. The cocci were usually large and arranged in extremely long chains. The results of these experiments will be found in the following table:

*Influence of streptococcus on the production of catalase.*

| No. of sample. | Description of sample. | Catalase (gas produced). | Time. |
|---|---|---|---|
| | | *C. c.* | |
| 1 | 9 c. c. sterile milk + 3 c. c. 1 per cent solution of hydrogen peroxid..... | 0 | 2 hours. |
| 2 | 9 c. c. sterile milk + 1 drop 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 0 | 2 hours. |
| 3 | 9 c. c. sterile milk + 3 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 0.5 | 2 hours. |
| 4 | 9 c. c. sterile milk + 6 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 1 | 2 hours. |
| 5 | 9 c. c. sterile milk + 10 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 1 | 2 hours. |
| 6 | 9 c. c. sterile milk + 15 drops 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 1 | 2 hours. |
| 7 | 3 c. c. 24-hours-old bouillon culture + 3 c. c. 1 per cent solution of hydrogen peroxid. | 0 | 2 hours. |

The *Bacillus prodigiosus*, *B. subtilis*, *B. proteus*, and *B. coli* were all found to increase greatly the production of catalase. Contrary to some investigators, we found the *Bacillus acidi lactici* to produce a small amount of catalase, and the streptococcus used in these experiments also produced only a small amount of catalase. Further investigations will be necessary to enable us to state just what types of streptococci are producers of catalase.

#### INFLUENCE OF COLOSTRUM ON THE PRODUCTION OF CATALASE.

It has been proven by other investigators that colostrum contains a large amount of the catalase ferment. In order to verify these results, a sample of colostrum was used in this experiment. The colostrum, cream of colostrum, skimmed colostrum, and the leucocytes plus a trace of skimmed colostrum were used to note the difference upon the production of catalase. The number of bacteria contained in the mixture of colostrum was 6,204,000 per cubic centimeter. The results of this experiment are found in the following table:

*Catalase in colostrum.*

| Description of sample. | Gas produced in 45 minutes. |
|---|---|
| | *C. c.* |
| Colostrum | 16 |
| Cream of colostrum | 7 |
| Skimmed colostrum | 7.5 |
| Leucocytes plus trace of skimmed colostrum | 0.5 |

Our experiments with colostrum confirmed the results of others, that this product is very rich in catalase ferment.

### THE ACID TEST.

#### TECHNIQUE USED IN DETERMINING THE PER CENT OF ACID.

It is often necessary to know how much acid is present in a sample of milk. The amount of acid may be a suggestive indication of the age of the milk and of its care. There are two kinds of acidity in milk, (1) apparent acidity, and (2) acidity due to lactic acid. The apparent acidity is due to the presence in normal milk of casein and acid phosphates, which have the power, like free acids, of neutralizing alkalis. Acidity due to lactic acid is formed in milk after it is drawn, and is caused by the action of certain forms of bacteria upon milk sugar. In general, when milk contains over 0.10 per cent of acid it may be assumed that it contains some lactic acid.

The technique used in determining the per cent of acid is as follows: Fifty cubic centimeters of the sample of milk was placed in a sterile beaker, a few drops of phenolphthalein being used as an indicator. A one-tenth normal solution of sodium hydroxid was carefully added

from a burette until the milk assumed a pale pink color. The number of cubic centimeters of the tenth normal solution of sodium hydroxid used was recorded and the per cent of the lactic acid calculated by the following formula, the factor 0.009 being the number of grams of lactic acid that 1 c. c. of a tenth normal solution of sodium hydroxid will neutralize:

$$\frac{\text{No. c. c. N/10 NaOH used} \times 0.009 \times 100}{\text{No. c. c. milk used.}} = \text{per cent.}$$

## THE REDUCTASE TEST.

The reductase test is claimed by some authorities to give a quick and approximate idea of the number of bacteria contained in milk. Milk contains a reducing property which is called reductase. Reductase is usually found in milk; sometimes a small amount is found in the blood. Bacteria found in milk when inoculated into sterile milk generate reductase. The reductase property in milk is destroyed when it is heated to 68° C. or higher for one-half hour. Pasteurized or boiled milk may by the development of bacteria regain its reductase property. The fat and cream contain more reductase than skimmed milk does. The centrifuged deposit of raw milk contains no reductase. In all pathological processes of the udder the reductase properties are increased. Reductase will reduce such stains as indigo, litmus, and methylene blue.

Expressions of reduction are varying and depend upon the reagents. There are two reagents used in performing the reduction test in milk. They are sometimes spoken of as the M and FM reagents. The M reagent consists of 5 c. c. of a saturated alcoholic solution of methylene blue and 195 c. c. of distilled water. The FM reagent, sometimes spoken of as Schardinger reagent, consists of 5 c. c. of saturated alcoholic solution of methylene blue, 5 c. c. of formalin, and 190 c. c. of distilled water. The symbols M and FM are sometimes termed respectively the Jensen and Schardinger Loebeck reagents.

### LITERATURE.

Seligmann distinguished three forms of reductase: (1) Hydrogenesis, having the property of reducing hydrogen sulphid; (2) reductase, having the property of reducing methylene blue; (3) aldehyde reductase, having the property of reducing Schardinger's reagent. He states that reductase is precipitated with the casein and is therefore attached to the casein particles in the same manner as it is attached to the fat globules, probably according to physical laws, and that it does not pass through a Pasteur porcelain candle. He claims that potassium rodanate and formalin influence the action of the reductase. He is also of the opinion that the reductase property is largely of bacterial origin. Seligmann's views are sup-

ported by Von Behring, who is of the opinion that when a sample of milk contains a small number of bacteria it will not have any great reducing property. Seligmann showed that sterilized milk could become reactive by raw milk or by bacteria.

Schardinger states that methylene blue is transformed in its leucobasis on account of bacteria.

Schmidt was of the opinion that the property of reductase increased with the age of the milk and could therefore be used to determine the number of bacteria present.

Muller has mentioned a test to determine the cleanliness and age of milk by means of a reduction test.

Konig's theory was that reductase was present in milk in two forms, free and combined. By the addition of a weak solution of alkali, the combined reductase became liberated and gave a much quicker reaction.

Schern states that colostrum only has reducing properties after standing for a considerable length of time, and milk of diseased udders does not reduce because it contains blood serum.

Trommsdorff believes the reductase to be of a bacterial origin, and according to his views the FM reductase is preexistent.

Koestler found different readings for the reductase and catalase in various udder diseases, but as a rule milk that showed a high catalytic activity was reduced in a short time.

Bredig and Sommer demonstrated on a chemical basis that the F and FM reductase were identical, and that the difference in the reaction depended upon the quantity of formalin used, and upon the reaction of the milk.

Jensen states that the reductase test can be used to advantage in connection with the fermentation test, because not only the number of bacteria is then indicated, but also the prevailing type. He used the methylene blue solution according to Barthel. On top of the milk and methylene blue solution in the tube he placed a few cubic centimeters of liquid paraffin. The tube was kept in a water bath at from 45 to 50° C. Milk containing more than 25,000,000 bacteria per cubic centimeter was decolorized in three hours; milk containing 7,000,000 bacteria was reduced in three hours, if the temperature did not go above 45° C. The temperature therefore had the greatest influence on the time of reduction. Milk which was decolorized in one-quarter of an hour at 45° C. was reduced in a shorter period when kept at 50° C. In slowly reducing milk, the reduction sometimes takes place quicker at 40° than at 50° C. This is explained by the fact that only the reductase which is present from the beginning will react at the optimum temperature of 50° C. In slowly reducing milk the reductase practically depends upon the multiplication of the bacteria. The quantity of methylene blue added has less influence than the

temperature on the reductase. The following table, from Jensen, will illustrate this point:

*Jensen's results with the reductase test.*

| Number of bacteria per cubic centimeter in milk. | Methylene blue solution— | |
|---|---|---|
| | 1 c. c. | 2 c. c. |
| 264,000,000 | 1 minute. | 1 minute. |
| 81,800,000 | 3 minutes. | 5 minutes. |
| 80,000,000 | 5 minutes. | 6 minutes. |
| 77,600,000 | 3 minutes. | 4 minutes. |
| 49,000,000 | 10 minutes. | 12 minutes. |
| 11,000,000 | 40 minutes. | 45 minutes. |
| 7,000,000 | 1 hour. | 1½ hours. |
| 3,000,000 | 2¾ hours. | 4¼ hours. |
| 2,800,000 | 5¾ hours. | 6¼ hours. |
| 1,800,000 | 9½ hours. | 10 hours. |
| 1,600,000 | 7½ hours. | 8 hours. |
| 1,000,000 | 6¾ hours. | 7¾ hours. |
| 370,000 | 11 hours. | 11½ hours. |
| 126,000 | 9½ hours. | 10¼ hours. |

Jensen showed that part of the reductase and catalase in milk is derived from the leucocytes and part from bacteria. The reduction takes place inside of the cell, and therefore the passage of the stain through the same indicates the time which is necessary for the process of decolorization, and correlation between the time of reduction and the number of bacteria may be observed. This correlation is therefore greatly influenced because the different types of bacteria do not all reduce in the same interval of time. The very slow reducing bacteria are usually of the lactic acid type. The most accurate results for the determination of bacteria are obtained when the shortest time is required for the reduction and the test is carried out at 38° C., and one-half of the methylene blue as recommended by Barthel is used. A concentrated solution of methylene blue has an antagonistic influence on the lactic acid bacteria. Jensen states that four groups of reduction can be made according to the number of bacteria:

(1) Good milk that contains not more than 100,000 bacteria per cubic centimeter will require 7 hours or longer for the reduction. (2) Moderately good milk that contains from 100,000 to 2,000,000 bacteria will be decolorized in from 2 to 7 hours. (3) Bad milk that contains from 2,000,000 to 20,000,000 bacteria per cubic centimeter will be decolorized in from one-fourth to two hours. (4) Very bad milk that contains over 20,000,000 bacteria will be reduced in less than a quarter of an hour. Certain conditions have to be observed regarding the temperature and condition of the milk. Jensen has combined

the reduction test with the Swiss fermentation test by keeping the test tube at 37° C. until the character of the curd could be observed.

### THE AUTHOR'S EXPERIMENTS WITH THE REDUCTASE TEST.

The two methods generally applied in this country are those of Jensen and Loebeck. The Jensen method, or the M reagent, was considered by the present writer to be the most reliable and was used in his experiments. The technique is as follows: Forty cubic centimeters of milk was placed in a large test tube with 1 cubic centimeter of a 2.5 per cent solution of methylene blue. This was thoroughly mixed and placed in an incubator at 37° C. Observations were made at various intervals to note the time of complete reduction. The standard, by this method, is that good milk should not be reduced in less than 7 hours. In 50 per cent of the samples examined the milk was reduced in less than 7 hours, and the bacterial count in most instances was rather high. Like the alcohol reaction, it did not always correspond with a high percentage of acid.

The statements of Jensen can, therefore, from our own experiments, be confirmed.

## THE SWISS FERMENTATION TEST.

### LITERATURE.

The fermentation test was first described by Walter. Gerber and Peter applied the test and found it to be a great success, particularly in cheese-manufacturing countries. The milk was kept in glass tubes in a water bath of 38° to 39° C. and observed at various intervals to note the time of coagulation and the character of the curd. If the curd was smooth and contained no peptonizing bacteria or gas bubbles, the milk was considered of a good quality for food. When the curd assumed a dirty white color the milk was supposed to contain bacteria which were not favorable for the production of cheese. Jensen classified the coagulation of curd (according to Peter) into four classes—(1) jellylike, (2) gaseous, (3) a cheesy or peptonized curd, and (4) no curd or gases. The first indicated that the lactic acid bacteria were most prevalent; the second indicated the presence of gas bacteria, such as *Bacillus coli*, *B. aerogenes*, etc.; the third, that the curd was produced by peptonizing bacteria, such as *B. subtilis* and *B. mesentericus*. He used different symbols to represent these three varieties of curds.

### THE AUTHOR'S METHOD OF PERFORMING THE FERMENTATION TEST.

The fermentation test was performed by the author as follows: Forty cubic centimeters of milk was placed in a large test tube and

incubated at 37° C. for 48 hours. The character of the curd was then noted, using the following symbols:

J1, indicating an ordinary lactic acid curd.
J2, indicating a firmer and smoother curd.
J3, indicating a very fine and jellylike lactic acid curd.
G1, indicating a small amount of gas production.
G2, indicating a moderate amount of gas production.
G3, indicating a large amount of gas production.
P1, indicating a small amount of peptonization or digestion.
P2, indicating a moderate amount of peptonization or digestion.
P3, indicating a large amount of peptonization or digestion.

The results of the experiments with the fermentation test will be found in the table beginning on page 220.

## THE ALCOHOL TEST.

The alcohol test was originally used to determine the percentage of acid in milk. During the last 6 years it has been demonstrated that a positive alcohol reaction can be obtained when the milk does not contain a large per cent of acid. The main object of the alcohol test at the present time is to determine the presence of a diseased condition of the udder. The alcohol test is used at times by a few creameries to ascertain roughly the amount of acid in milk before churning.

### LITERATURE.

Weigmann is of the opinion that the alcohol test should be used only to determine the percentage of acid, and not to detect a diseased condition of the udder.

Auzinger states that colostrum reacts to the alcohol test, and in some cases he found the reaction to be positive for the first 43 days in the animal's period of lactation. He also states that cows suffering from mastitis and cows well advanced in their period of lactation will give a positive reaction. Cows being fed on phosphate of lime gave a positive reaction with fresh milk.

Höyberg found that mixed milk often gave a positive alcohol reaction when only a small per cent of it came from diseased cows. He also found that 9.2 per cent of his milk samples gave a positive alcohol reaction, but contained only a very small per cent of acid when tested with a one-tenth normal solution of sodium hydroxid.

Raudnitz considered the alcohol test a more accurate method for determining acid in milk because it depended largely on the casein, while the acid test depended on the acidity of the phosphates.

### TECHNIQUE.

The alcohol test is performed as follows: Five cubic centimeters of milk is placed in a clean, sterile test tube, and 5 c. c. of 68 per

cent alcohol is added. The mixture is then shaken, and if any flocculi or curd are deposited on the walls of the tube the reaction is considered positive.

## EXPERIMENTS TO DETERMINE WHAT SUBSTANCES INFLUENCE THE ALCOHOL REACTION.

Experiments were performed to determine the influence of beef serum on the alcohol reaction, two kinds being used, one preserved with chloroform, the other with normal serum. Experiments were also performed for which different amounts of egg albumen were used. The result of these experiments will be found in the following tables:

*Influence of cattle blood serum preserved with chloroform upon alcohol test.*

| No. of sample. | Amount of serum added. | Amount of milk in tube. | Alcohol test. |
|---|---|---|---|
| | *C. c.* | *C. c.* | |
| 1 | 0 | 5 | Negative. |
| 2 | 0 | 5 | Do. |
| 3 | 0.1 | 5 | Do. |
| 4 | 0.2 | 5 | Do. |
| 5 | 0.3 | 5 | Do. |
| 6 | 0.5 | 5 | Do. |
| 7 | 0.6 | 5 | Do. |
| 8 | 1 | 5 | Do. |
| 9 | 5 | 5 | Do. |
| 10 | 5 | ..... | Do. |

*Influence of fresh defibrinated cattle blood serum upon alcohol test.*

| No. of sample. | Amount of serum added. | Amount of milk in tube. | Alcohol test. |
|---|---|---|---|
| | *C. c.* | *C. c.* | |
| 1 | 0 | 5 | Negative. |
| 2 | 0 | 5 | Do. |
| 3 | 0.1 | 5 | Do. |
| 4 | 0.2 | 5 | Do. |
| 5 | 0.3 | 5 | Do. |
| 6 | 0.5 | 5 | Do. |
| 7 | 0.6 | 5 | Do. |
| 8 | 1 | 5 | Do. |
| 9 | 5 | 5 | Do. |
| 10 | 5 | ..... | Do. |

In order to determine the influence of albumin upon the alcohol test, the white of an egg was added to 100 c. c. of normal saline

solution, and different amounts of this mixture were added to the different tubes, with the following results:

*Influence of albumin upon alcohol test.*

| No. of tube. | Amount of albumin mixture added. | Amount of 68 per cent alcohol. | Amount normal milk added. | Alcohol test. |
|---|---|---|---|---|
| | *C. c.* | | *C. c.* | |
| 1 | 0 | 5 | 5 | Negative. |
| 2 | 0.1 | 5 | 5 | Do. |
| 3 | 0.2 | 5 | 5 | Do. |
| 4 | 0.3 | 5 | 5 | Do. |
| 5 | 0.5 | 5 | 5 | Do. |
| 6 | 1 | 5 | 5 | Positive. |
| 7 | 1.5 | 5 | 5 | Do. |
| 8 | 2 | 5 | 5 | Do. |
| 9 | 3 | 5 | 5 | Do. |
| 10 | 5 | 5 | 5 | Do. |
| 11 | 1 | 5 | Sterile water. | Do. |

The results of the foregoing experiments proved that cattle serum had no influence on the alcohol reaction. The egg albumen gave a positive reaction in every instance where 1 c. c. or more of the mixture, as shown in the table, was added. This would seem to prove that when milk contains a certain amount of albumin it influences the alcohol reaction. However, sufficient work has not been performed to state definitely that albumin is the cause of the alcohol reaction.

Little is known regarding what substances present in milk influence the alcohol reaction when it contains a small per cent of acid. Undoubtedly, the presence of leucocytes influences the alcohol reaction. Colostrum, milk from cows suffering from mastitis, and milk from cows well advanced in their period of lactation often contain a large number of leucocytes, and may partially explain the alcohol reaction in these cases.

In the author's experiments, sample No. 89, which was colostrum, did not react to the alcohol test. Certain substances were probably present in this particular sample which influenced the alcohol reaction. In experiments with 100 samples the alcohol test was compared with the bacterial count, and 36 per cent gave a positive alcohol reaction. The positive reaction did not always correspond with the high per cent of acid, but it is of value in determining a diseased condition of the udder. In a majority of instances where there was a positive alcohol reaction there were a large number of bacteria, but when the number was small they were usually of a type foreign to good, normal milk.

## COMPARISON OF BIOCHEMIC REACTIONS WITH THE BACTERIAL COUNT.

### LITERATURE.

Jensen, Von Heygendorff and Meurer, and others have compared the quantity of bacteria with one or two of the biochemic tests. The results of Von Heygendorff and Meurer are shown in the following table:

*Comparison of catalase test with number of bacteria by Von Heygendorff and Meurer.*

| Samples. | Date. | Catalase. | Number of bacteria. | Proportional increase. | Remarks. |
|---|---|---|---|---|---|
| | | C. c. | | | |
| I | Apr. 28 | 1.5 | 19,000 | ..... | 2 hours. |
| After 24 hours | Apr. 29 | 3.7 | 290,000 | 15 × | Ice chest. |
| After 48 hours | Apr. 30 | 9.5 | 700,000 | 3 × | Do. |
| Infected with *coli* after 24 hours | Apr. 29 | [1] 10.0 | 34,000,000 | ..... | Within 70 minutes. |
| II | Apr. 29 | 2.1 | 27,000 | ..... | |
| After 24 hours | Apr. 30 | 8.8 | 19,000,000 | 704 × | Room temperature. |
| After 48 hours | May 1 | 10.1 | 100,000,000 | 5 × | Within 40 minutes. |
| Infected with *coli* after 24 hours | Apr. 30 | 10.0 | 120,000,000 | ..... | Within 49 minutes. |
| III | May 1 | 0.7 | 12,000 | ..... | |
| After 24 hours | May 2 | 2.5 | 300,000 | 25 × | Ice chest. |
| After 48 hours | May 3 | 6.7 | 2,500,000 | 8 × | Do. |
| After 24 hours | May 2 | 9.0 | 90,000,000 | ..... | Room temperature. |
| After 48 hours | May 3 | ([2]) | ..... | ..... | Do. |
| Infected with *coli* after 24 hours | May 2 | 10.0 | 70,000,000 | ..... | Do. |
| VI | May 7 | 4.1 | 1,000,000 | ..... | |
| After 24 hours | May 8 | 10.0 | 100,000,000 | 100 × | In 4 hours. |
| XI | ..... | 4.2 | 210,000 | ..... | |
| After 24 hours | ..... | 9.3 | 75,000,000 | 357 × | |

[1] Immediate gas production. [2] Sour.

### THE AUTHOR'S EXPERIMENTS.

As the results obtained by other investigators, as shown above, were very encouraging, the writer experimented with 100 different samples in the following manner:

One hundred samples were collected from various stores and dealers throughout the city of Philadelphia during the year 1911 and brought immediately to the laboratory for examination. A bacterial count was made as follows: One cubic centimeter of the milk was placed in a bottle containing 199 c. c. of sterile water, and 1 c. c. of this mixture was placed in another bottle containing 49 c. c. of sterile water. Three plates were made from every sample. One-tenth of 1 c. c. from the first bottle was placed in plate No. 1; 0.2 c. c. of the mixture from the first bottle was placed in plate No. 2; 0.3 c. c. of the mixture from the second dilution was placed in plate No. 3. Plain agar, which had previously been boiled and cooled to 42° C. for 15 minutes, was added to each of the three plates and mixed with the dilutions

of the milk. After the agar plates were cooled they were placed in an incubator at 37° C. for 24 hours and at room temperature for 24 hours. The number of colonies on the three plates was then counted and the number of bacteria estimated per cubic centimeter.

The following tables show the comparison of the different tests previously described:

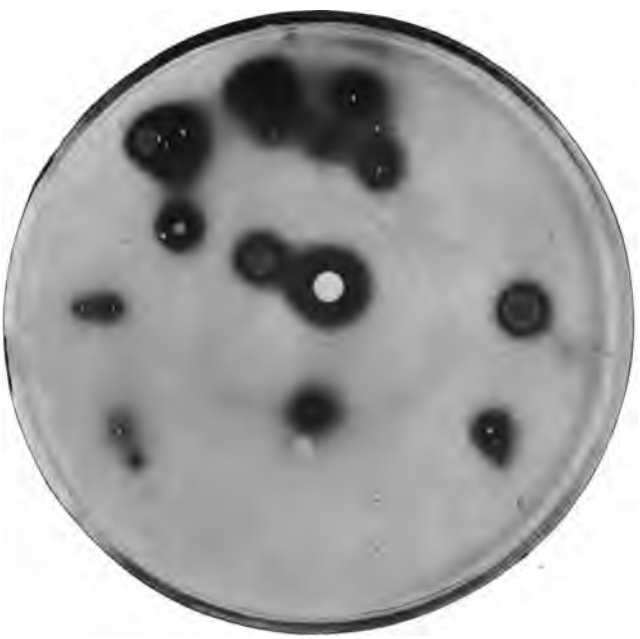
*Tabulated results from 100 samples of milk examined.*

| No. of sample. | Catalase test—gas produced in 2 hours. | Per cent acid. | Jensen reduction test—time required. | Fermentation test—character of curd.[1] | Alcohol test. | Temperature of milk. | Number of bacteria per c. c. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | *C. c.* | | *Hours.* | | | ° *C.* | | |
| 1 | 1 | 0.216 | 26 | J1..... | Negative.. | 21 | 460 | |
| 2 | 3.5 | .218 | 18 | J1, G2..... | ...do..... | 19 | 2,660 | |
| 3 | 1 | .212 | 18 | J1, G2..... | ..do..... | 18 | 204,600 | |
| 4 | 1 | .234 | 24 | J2..... | ..do..... | 20 | 2,700 | |
| 5 | 2 | .219 | 18 | J1..... | ...do..... | 15 | 36,100 | |
| 6 | 3 | .261 | 18 | G1..... | ...do..... | 14 | 9,200 | |
| 7 | 1.5 | .214 | 2½ | G1..... | ...do..... | 21 | 184,000 | |
| 8 | 5 | .264 | 1 | G2..... | Positive... | 20 | 624,000 | Many liquefiers. |
| 9 | 3 | .25 | 18 | J2, G1..... | Negative.. | 15 | 170,200 | |
| 10 | 3 | .243 | 18 | P3, G1..... | ...do..... | 16 | 94,100 | |
| 11 | 0 | .234 | 18 | J2..... | ...do..... | 21 | 4,300 | Pasteurized. |
| 12 | 2.5 | .23 | 18 | P2, G3..... | ...do..... | 19 | 412,000 | |
| 13 | 3.5 | .244 | 18 | J2..... | ...do..... | 18 | 16,400 | |
| 14 | 2 | .261 | 18 | J2..... | ...do..... | 19 | 8,300 | |
| 15 | 4.5 | .27 | 18 | J1, G1..... | Positive... | 17 | 30,600 | |
| 16 | 1.5 | .26 | 18 | J3..... | Negative.. | 22 | 220 | Pasteurized. |
| 17 | 3 | .274 | 18 | J2, G1..... | Positive... | 21 | 6,300 | |
| 18 | 3.5 | .216 | 6 | J2..... | ...do..... | 18 | 144,000 | |
| 19 | 5.5 | .252 | ½ | P2, G2..... | ...do..... | 17 | 647,000 | |
| 20 | 5 | .32 | 6 | P1, J1..... | ...do..... | 17 | 42,000 | |
| 21 | 1 | .23 | ..... | P3, G2..... | Negative.. | 16 | 640 | |
| 22 | 2.5 | .18 | 10 | J3..... | Positive... | 14 | 16,000 | |
| 23 | 4.4 | .199 | 10 | P2, G3..... | ...do..... | 15 | 28,600 | |
| 24 | 5.5 | .153 | 5 | P3..... | ...do..... | 16 | 368,000 | Cow suffering from a bad case of intestinal catarrh. |
| 25 | 2.5 | .27 | 5 | P3, G3..... | ...do..... | 18 | 59,200 | |
| 26 | 4.5 | .21 | (2) | J3..... | ...do..... | 19 | 28,100 | |
| 27 | 3 | .19 | (2) | J3..... | Negative.. | 18 | 84,600 | |
| 28 | 2 | .21 | (2) | J3..... | ...do..... | 16 | 93,200 | |
| 29 | 3 | .25 | 2 | J2..... | Positive... | 18 | 1,420,000 | |
| 30 | 2.5 | .19 | (2) | J1..... | Negative.. | 17 | 2,140,000 | |
| 31 | 5 | .189 | 3 | J2, G2..... | ...do..... | 18 | 3,260,000 | |
| 32 | 2.5 | .192 | (2) | J1..... | ...do..... | 19 | 724,000 | |
| 33 | 1.5 | .234 | (2) | J1..... | ...do..... | 24 | 308,000 | |
| 34 | 6.5 | .27 | 1 | J1, G1..... | Positive... | 23 | 21,312,000 | Tested for nitrates; negative. Leucocytes not above normal. |

[1] For explanation of symbols indicating character of curd in fermentation test, see p. 216.

[2] No reduction.

*A*



*B*

CASEIN-AGAR PLATE SHOWING BACTERIAL COLONIES, BEFORE AND AFTER TREATMENT WITH TENTH-NORMAL LACTIC ACID.

*A*, Plate showing bacterial colonies. *B*, Same plate after treatment with tenth-normal lactic acid. Clear zones on *B* mark the peptonizing colonies.

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*Tabulated results from 100 samples of milk examined*—Continued.

| No. of sample. | Catalase test—gas produced in 2 hours. | Per cent acid. | Jensen reduction test—time required. | Fermentation test—character of curd. | Alcohol test. | Temperature of milk. | Number of bacteria per c. c. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | *C. c* | | *Hours.* | | | ° *C.* | | |
| 35 | 5.5 | 0.20 | 2 | J2..... | Positive.. | 25 | 350,000 | |
| 36 | 4.5 | .19 | 1 | J2, G1..... | ...do..... | 22 | 1,110,000 | |
| 37 | 8 | .196 | 1 | J1, G3..... | ...do..... | 20 | 1,870,000 | |
| 38 | 5.5 | .206 | 1 | J3, G2..... | ...do..... | 21 | 6,420,000 | |
| 39 | 5 | .252 | 1 | J1, G3..... | ...do..... | 20 | 4,812,000 | |
| 40 | 2 | .196 | 8 | J2..... | Negative.. | 19 | 1,208,000 | |
| 41 | 1.5 | .194 | 6 | J2, G1..... | ...do..... | 18 | 624,000 | |
| 42 | 3.5 | .225 | 1 | J1..... | Positive... | 16 | 118,000 | |
| 43 | 1 | .183 | (1) | J2..... | Negative.. | 16 | 84,000 | |
| 44 | 5.5 | .255 | ½ | J1..... | Positive... | 16 | 1,210,000 | |
| 45 | 8 | .25 | ½ | J1, G2..... | ...do..... | 17 | 1,300,000 | |
| 46 | 4.5 | .241 | 7 | J1, P2..... | Negative.. | 15 | 2,108,000 | |
| 47 | 1,25 | .16 | 7 | J3..... | ...do..... | 15 | 11,300 | |
| 48 | 1.5 | .18 | (1) | J3..... | ...do..... | 15 | 4,250 | |
| 49 | .75 | .191 | (1) | J3..... | ...do..... | 15 | 3,400 | |
| 50 | .5 | .175 | (1) | J3..... | ...do..... | 15 | 1,120 | |
| 51 | 3 | .20 | 7 | J2..... | ...do..... | 23 | 124,000 | |
| 52 | 5 | .198 | ½ | J3..... | Positive... | 23 | 683,000 | |
| 53 | 2 | .185 | 7 | J2..... | Negative.. | 21 | 142,000 | |
| 54 | 5.5 | .18 | ½ | J3..... | ...do..... | 22.5 | 1,268,000 | |
| 55 | 2.5 | .207 | 7 | J2..... | Positive... | 23 | 1,820,000 | |
| 56 | 2 | .18 | 7 | J2, G2..... | ...do..... | 23 | 24,000 | |
| 57 | 2 | .22 | 9 | J3..... | Negative.. | 18 | 22,800 | |
| 58 | 3 | .192 | 1 | J2..... | Positive... | 24 | 1,512,000 | |
| 59 | 2.5 | .186 | 7 | J2, G1..... | Negative.. | 24 | 510,000 | |
| 60 | 2 | .19 | 7 | J2..... | ...do..... | 21 | 208,000 | |
| 61 | 4.5 | .192 | 7 | J1, G2..... | ...do..... | 20 | 1,106,000 | |
| 62 | 4 | .185 | 1 | J2..... | ...do..... | 18 | 4,820,000 | |
| 63 | 5 | .187 | 1 | J2, G1..... | ...do..... | 19 | 3,231,000 | |
| 64 | 4.5 | .198 | ½ | J3..... | ...do..... | 24 | 1,226,000 | |
| 65 | 4 | .21 | 1 | J1, G1..... | ...do..... | 22 | 1,108,000 | |
| 66 | 4.2 | .23 | ½ | J1, G2..... | Positive... | 22 | 2,642,000 | |
| 67 | 4 | .181 | 1 | P2, G2..... | Negative.. | 23 | 1,102,000 | |
| 68 | 3 | .192 | 7 | J2, G1..... | Positive... | 24 | 108,000 | |
| 69 | 2 | .288 | ½ | J3..... | ...do..... | 20 | 1,643,000 | |
| 70 | 4 | .16 | 1 | J1, G3..... | Negative.. | 20 | 8,710,000 | |
| 71 | 3.5 | .27 | ½ | P2, G3..... | Positive... | 20 | 7,218,000 | |
| 72 | 4 | .201 | ½ | J2, G1..... | Negative.. | 22 | 1,108,000 | |
| 73 | 5 | .461 | ½ | J3, G1, P2..... | Positive... | 22 | 20,340,000 | Streptococci. |
| 74 | 4.5 | .181 | 2 | J1, G3..... | Negative.. | 21 | 428,000 | |
| 75 | 5.5 | .214 | ½ | J1, G2..... | ...do..... | 22 | 1,309,000 | |
| 76 | 2 | .218 | ½ | J2, P1..... | ...do..... | 23 | 1,825,000 | |
| 77 | 5.25 | .30 | ½ | J2, G2..... | Positive... | 22 | 7,643,000 | |
| 78 | 5 | .291 | ½ | J1, G2..... | ...do..... | 23 | 5,207,000 | |
| 79 | [2]2.5 | .284 | ½ | J3..... | Negative.. | 22 | 1,429,000 | |
| 80 | 8 | .216 | ½ | J2, G2..... | ...do..... | 17 | 30,204,000 | Colostrum. |
| 81 | 3 | .207 | 7 | J2, G1, P1..... | ...do..... | 21 | 606,000 | |
| 82 | 2 | .198 | 7 | J3..... | ...do..... | 22 | 743,000 | |
| 83 | 1½ | .189 | 18 | J1, P3..... | ...do..... | 23 | 526,000 | |
| 84 | 6½ | .225 | ½ | J1, G2..... | Positive... | 22 | 3,111,000 | |

[1] No reduction.

[2] One-half hour.

*Tabulated results from 100 samples of milk examined*—Continued.

| No. of sample. | Catalase test—gas produced in 2 hours. | Per cent acid. | Jensen reduction test—time required. | Fermentation test—character of curd. | Alcohol test. | Temperature of milk. | Number of bacteria per c. c. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | *C. c.* | | *Hours.* | | | *° C.* | | |
| 85 | 6 | 0.32 | ½ | J1, G2, P2..... | Positive... | 21 | 4,920,000 | Streptococci. |
| 86 | 2 | .28 | 2 | J3..... | Negative.. | 20 | 72,000 | |
| 87 | 5.25 | .281 | ¾ | J1, G2..... | ...do..... | 21 | 1,208,000 | |
| 88 | 5 | .30 | ½ | G1, P4..... | Positive... | 22 | 2,536,000 | |
| 89 | 1½ | .18 | ½ | J2, G2..... | ...do..... | 20 | 723,000 | |
| 90 | 3 | .216 | 2 | J3..... | Negative.. | 22 | 2,154,000 | |
| 91 | 5 | .198 | ½ | J1..... | Positive... | 21 | 5,168,000 | |
| 92 | 3 | .214 | ½ | J2..... | Negative.. | 19 | 3,726,000 | |
| 93 | 2.5 | .281 | ½ | J1, G2..... | ...do..... | 22 | 1,362,000 | |
| 94 | 2 | .21 | 7 | J2, P2..... | ...do..... | 21 | 151,000 | |
| 95 | 2.25 | .197 | 7 | J3..... | ...do..... | 22 | 860,000 | |
| 96 | 3 | .189 | 10 | J1, G1, P2..... | ...do..... | 20 | 143,000 | |
| 97 | 1.5 | .198 | 10 | G2, P3..... | ...do..... | 22 | 426,000 | |
| 98 | 1.75 | .171 | 7 | J3..... | ...do..... | 22 | 208,000 | |
| 99 | 3.75 | .187 | 10 | G2, P3..... | ...do..... | 21 | 322,000 | |
| 100 | 2.5 | .185 | 2 | J2..... | ...do..... | 23 | 224,000 | |

## CONCLUSIONS.

The results of the foregoing table, showing the comparison of the different tests applied, seem in a general way to confirm the opinions of the other investigators.

Of the 100 samples examined, 38 gave a catalase reading of 4 c. c. or more of gas. The average number of bacteria contained in these 38 samples was 4,067,260. Of these samples 36.8 per cent gave a negative reaction to the alcohol test, and 63.2 per cent gave a positive reaction. Other investigators seem to find considerable variation in their results in comparing these two different biochemic reactions. Since no further experiments as to the nature of this difference have been carried out, I am not in a position to confirm entirely the statements of other investigators. Undoubtedly, the alcohol test is a simple one, and very small alterations in the udder can be readily detected by this test. More experiments will have to be performed in order to determine the exact cause of these variations. In the two samples where streptoccocci were found on the plates the catalase reading was high and the alcohol reaction was positive. It seems from our experiments that a case of mammitis could be determined at the dairy with these two tests without a bacterial count.

The reduction test agreed in most instances with the bacterial count; that is, whenever the sample was reduced in a short time the bacterial count was high.

The fermentation test corresponded in the majority of instances to the kind of bacteria found on the plates. If a large number of *Bacillus*

*subtilis* or *B. mesentericus* were found present on the plates, the curd was usually peptonized or digested to a certain degree.

The acidity and temperature gave some indication of the dilutions that were necessary for a bacterial count. In the samples examined the acidity was fairly high, this probably being due to the age of the milk when received at the laboratory. The age of the milk, so far as could be ascertained, was about 24 hours. The temperature of the milk, as seen by the tables, ranged between 14° and 25° C.

In conclusion, the results of the experiments largely confirm the results of the investigators mentioned, and may permit the following deductions:

The biochemic tests used are simple in their technique. The results obtained are practically as good as those shown by plating, so far as estimating the number of bacteria is concerned. Many different affections of the animal, also various pathological conditions of the udder, can be detected by these tests, and they would materially aid a clinical examination. Pathological excretions from the udder can be demonstrated by the biochemic tests, whereas a chemical and bacteriological examination often gives negative results.

Further investigations will undoubtedly be necessary to form definite conclusions, but from this brief experiment it is hoped that others may be inspired to engage themselves in similar work.

These tests, if applied at the dairy or site of milk production, would greatly aid the health officials in controlling a milk supply.

## ACKNOWLEDGMENT.

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# CASEIN MEDIA ADAPTED TO THE BACTERIAL EXAMINATION OF MILK.

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## INTRODUCTION.

The use of casein as an ingredient of artificial media for the bacterial examination of milk seems logical, since bacteria which grow in milk are able to utilize casein as a food material to some extent at least. Casein as far as known has never been used for a solid medium. It has been sometimes introduced into solid media by the addition of milk, and the soluble sodium phosphate casein, known as nutrose, has been used as an artificial milk for bacteriological purposes.

## PREPARATION OF CASEIN-AGAR.

The method of preparation of casein-agar is as follows:

### PREPARATION OF ONE LITER.

*Casein solution*

300 c. c. distilled water, 10 grams casein (Eimer & Amend C. P. casein prepared according to Hammarsten), 7 c. c. normal sodium hydroxid.

After dissolving casein make up to 500 cubic centimeters.

*Agar solution.*

500 c. c. distilled water, 10 grams agar.

To 300 c. c. of water (distilled) add 10 grams casein (Eimer & Amend C. P. casein prepared according to Hammarsten) and 7 c. c normal sodium hydroxid. Dissolve casein by heating to boiling. It is desirable to let this stand for several hours to get a perfect solution. This is not necessary, however. Make up volume to 500 c. c., and bring the reaction of the solution to between +0.1 and +0.2, Fuller's scale. Do not allow solution to become alkaline to phenolphthalein or over +0.2. If the casein is weighed accurately and the normal solution is accurate the reaction will be about +0.2.

The agar solution is prepared by dissolving 10 grams of agar in 500 c. c. of water.

Both casein and agar solutions should be filtered, then mixed. Tube and sterilize in autoclave under pressure for 20 minutes; then

cool the tubes quickly in cold water or ice water. The final reaction of the medium will be about +0.1, Fuller's scale. If the medium is alkaline the bacterial growth will be restricted. If the medium is more than +0.1 some of the casein may be precipitated during sterilization. The casein-agar should be clear and almost colorless when poured into a Petri dish. Sometimes the casein will be slightly precipitated during sterilization or the cooling, but this is of no consequence, since on pouring into plates the precipitate, on account of its finely divided condition, becomes invisible.

### COMPARISON OF BACTERIAL COUNTS ON CASEIN-AGAR AND INFUSION AGAR INCUBATED FOR 24 HOURS AT 37° C.

A comparison of the bacterial counts made on casein-agar and infusion agar show many interesting facts. Table 1[1] shows a comparison of counts after 24 hours' incubation at 37° C. It may be seen that of the 26 samples of raw milk examined, 24, or 92.3 per cent, showed higher counts on infusion agar. The same samples of milk after pasteurization in the laboratory gave different results, as may be seen from the table. Twelve of the 24 samples, or 50 per cent, showed higher counts on infusion agar, instead of 92.3 per cent as shown with raw milk. These results show that casein-agar does not give as high counts after 24 hours' incubation as does infusion agar. The comparison of the bacterial counts using raw and pasteurized milk indicates that casein-agar will show higher counts when pasteurized milk is examined.

### COMPARISON OF BACTERIAL COUNTS ON CASEIN-AGAR AND INFUSION AGAR INCUBATED FOR SIX DAYS AT 30° C.

The comparative results after 24 hours' incubation showed that a longer incubation was necessary. Table 2 shows the total counts on casein-agar and infusion agar after 6 days' incubation at 30° C. Raw milk and the same milk after pasteurization in the laboratory were examined. Of the 50 samples of raw milk, 22, or 44 per cent, showed higher counts on casein-agar. After pasteurization, 39, or 78 per cent, of the samples showed higher counts on casein-agar. From these figures it is evident that a 6 days' incubation at 30° gives far better results on casein-agar than a 24 hours' incubation at 37° C.

It may seem from Table 2 that when raw milk is being examined casein-agar compares favorably with infusion agar. While in some samples the count was lower on casein-agar, in others it was higher. The results using pasteurized milk show much higher counts on casein-agar. In many samples the counts were doubled.

[1] The tables are at the end of the paper.

A few more comparative results are shown in Table 3. Seven out of 11 samples of raw milk showed higher counts on casein-agar. It is interesting to note the increased count in samples 5 and 6 of the raw milk. It is often found that raw milk of the certified grade shows much higher counts on casein-agar. Of the 8 samples of commercially pasteurized milk 7 showed higher counts on casein-agar. In many cases the counts were more than doubled.

### COMPARISON OF BACTERIAL COUNTS ON LITMUS-LACTOSE-GELATIN AND CASEIN-AGAR.

In order to determine the effect of incubation at low temperatures on the counts on casein-agar, 4 samples of pasteurized milk were examined. The counts were determined on litmus-lactose-gelatin and casein-agar, both incubated at 18° C. for 6 days. The results are shown in Table 4. It may be seen that in 3 of the 4 counts the results are much higher on casein-agar.

### THE BACTERIAL GROUPS WHICH DEVELOP ON CASEIN-AGAR AND INFUSION AGAR.

A comparison of the groups of bacteria which grow on infusion and casein-agar plates has been made by the following method: After a sample of milk was plated and the count determined each colony was picked off and inoculated into litmus milk tubes which were incubated at 30° C. for 14 days. The milk cultures were then examined and divided into groups according to the changes in the tubes. The reactions in the litmus milk then represented the action of the colonies on the original plate and made it possible to divide them into 5 groups, namely, acid-forming and coagulating, acid-forming, inert, alkali-forming, and peptonizing groups.

A large number of samples have been plated on casein-agar and infusion agar, and the percentages of the various groups have been averaged. Table 5 shows the averaged results of a number of samples of 3 grades of milk raw and the same milks pasteurized. A study of the table shows that the acid-forming bacteria do not grow as well on casein-agar. The inert, alkali-forming, and peptonizing groups seem to be favored.

### THE DIFFERENCE IN THE BACTERIAL GROUPS WHICH DEVELOP ON LACTOSE-AGAR AND CASEIN-AGAR.

The ability of casein to favor the growth of alkali-forming and peptonizing bacteria is shown more strikingly in Table 6, which shows the bacterial groups in ripened cream and in butter made

from the cream, as determined on lactose-agar and casein-agar.[1] The butter after churning was divided into 4 lots and treated in different ways, as indicated. It may be seen that in the ripened cream the lactose-agar plates showed no peptonizing organisms, while 31.75 per cent were determined from the casein plate. Among the 4 samples of butter only 1 showed any peptonizing organisms on lactose-agar, while 15, 9.33, 17.50, and 13.34 per cent, respectively, showed on casein-agar. The results with the alkali-forming organisms are even more striking, since none at all showed on the lactose-agar. It may be seen that the percentage of the total acid group was always lower on casein-agar, and that the total counts were lower than on lactose-agar. In these samples, at least, casein-agar showed a better representative flora of the bacteria existing in the ripened cream and butter, and the same has been true with regard to milk.

## THE DETERMINATION OF PEPTONIZING BACTERIA ON CASEIN-AGAR.

Casein-agar compares favorably with infusion agar as a medium for the determination of bacterial numbers, but its greatest value lies in the fact that while determining total bacteria the number of peptonizing organisms may be counted. To determine the peptonizing bacteria it is simply necessary after making the total count to flood the casein-agar plate with tenth-normal lactic acid. After the plate turns white the acid may be poured off. The action of the lactic acid is to precipitate the casein in solution, which produces an opaque white medium, except about peptonizing colonies where the casein has been dissolved by the peptonizing action of the bacteria. The peptonizing colonies are easily counted, as they then appear on the plate surrounded by a clear zone while the rest of the medium is an opaque white. The photographs in Plate XXX show a casein-agar plate before and after flowing with tenth-normal lactic acid. The clear zones about the peptonizing colonies show distinctly against the opaque white medium.

### ACCURACY OF THE METHOD.

In order to determine the accuracy of this method, 32 samples of raw milk have been studied. The peptonizing bacteria were determined by flowing casein plates with tenth-normal lactic acid, also by the tube method of picking off colonies and inoculating into litmus milk as described previously. A comparison was also made at the

[1] This work was carried on by Mr. J. R. Keithley, of the Dairy Division.

same time from infusion-agar plates using the tube method. The results are shown in Table 7. It may be seen that the results agree very closely. A series of 38 samples of pasteurized milk were also studied in the same way, and the results are shown in Table 8. It is apparent that peptonizing organisms may be determined from casein plates with accuracy.

### ADVANTAGE OF THE METHOD.

When gelatin is used for the determination of liquefying bacteria a low-temperature incubator is necessary and the plates may be lost through total liquefaction. These disadvantanges may be overcome by the use of casein-agar; and, further, the determination of peptonizing bacteria, using this medium, gives a direct count of the bacteria in milk which peptonize casein. The number of liquefying organisms shown by the liquefaction of gelatin is not a true measure of the number which peptonize casein, since numerous bacteria act on casein but do not liquefy gelatin, and the reverse may also be true.

### MODIFICATION OF CASEIN MEDIA.

Various kinds of media may be made using casein as the nutrient material. Sugars may be added, or the casein solution can be used as a liquid medium without agar.

Casein may be incorporated in other solutions to advantage. It has been found that a rennet-whey casein-agar affords a good medium for the growth of organisms of the *Bacillus bulgaricus* type as well as other bacteria which do not grow well on the ordinary media. When sugar is present the acid formed causes a clouding of the medium, due to the precipitation of the casein. It is therefore possible to distinguish acid-forming colonies by the clouding about the colony. This medium may be prepared by curdling fresh milk with rennet, then neutralizing the whey, which should then be heated and filtered until clear. The clear whey can then be substituted for the water in the formula given previously for the preparation of casein-agar.

### CONCLUSION.

1. Casein-agar should be incubated for 6 days at 30° C. in order to obtain the best results.

A 24 hours' period of incubation at 37° C. is not sufficient for satisfactory bacterial development.

2. The bacterial counts determined on casein-agar compare favorably with those on infusion agar and in many cases are much higher when the plates are properly incubated.

3. A study of the bacterial groups which grow on this medium indicates that a more representative flora develops than on the ordinary media. While the acid-forming organisms do not grow as well, the alkali-forming and the peptonizing bacteria are favored in their development on casein-agar.

4. The number of peptonizing bacteria in a sample of milk may be determined directly from a casein-agar plate by flowing with tenth-normal lactic acid.

5. Numerous modifications of this medium can be made. Sugars may be added, or the casein solution may be used as a liquid medium without the agar. Casein may also be incorporated in many of the ordinary media.

6. It is believed that the use of pure casein as a nutrient medium is a step toward the use of synthetic media. Since casein media can always be made uniform, they should prove to be of considerable value in bacteriological milk analysis.

TABLE 1.—*Comparison of bacterial counts on casein-agar and infusion agar after 24 hours' incubation at 37° C.*

| Raw milk. | | Pasteurized milk. | |
|---|---|---|---|
| Infusion agar. | Casein-agar. | Infusion agar. | Casein-agar. |
| 2,280,000 | 1,850,000 | 0 | 2,540 |
| 51,600,000 | 4,500,000 | 5,400 | 6,000 |
| 7,400,000 | 2,640,000 | 3,000 | 5,500 |
| 4,220,000 | 860,000 | 340 | 3,000 |
| 20,500,000 | 1,500,000 | 200 | 20,200 |
| 6,200,000 | 590,000 | 47,000 | 28,000 |
| 31,600,000 | 1,470,000 | 640 | 7,600 |
| 6,000,000 | 6,300,000 | [1]0 | 22,600 |
| 600,000 | 250,000 | 20,000 | 3,800 |
| 15,000,000 | 6,300,000 | 80 | [1]0 |
| 12,200,000 | 670,000 | 390 | 110 |
| 58,000,000 | 2,220,000 | 60 | [1]0 |
| 23,000,000 | 1,900,000 | 30 | 10 |
| 1,600,000 | 1,010,000 | 210 | 100 |
| 23,000,000 | 1,980,000 | 40 | 100 |
| 28,000,000 | 16,000,000 | 110 | 130 |
| 3,000 | [1]0 | ..... | ..... |
| 117,000 | 47,000 | 20 | 20 |
| 6,500 | 7,000 | ..... | ..... |
| 119,000 | 420 | 20 | 8 |
| 138,000 | 28,000 | 1,030 | 350 |
| 20,000 | 60 | 6 | 4 |
| 45,000 | 24,000 | 130 | 30 |
| 2,100 | 20 | [1]0 | 60 |
| 49,000 | 11,600 | 2,800 | 1,200 |
| 6,000 | 120 | [1]0 | 80 |

[1] One-tenth dilution.

TABLE 2.—*Comparison of bacterial counts on casein-agar and infusion agar after 6 days' incubation at 30° C.*

| Sample No. | Raw milk. | | Same milk pasteurized. | |
|---|---|---|---|---|
| | Infusion agar. | Casein-agar. | Infusion agar. | Casein-agar. |
| 1 | 1,440,000 | 1,260,000 | 22,900 | 28,100 |
| 2 | 2,460,000 | 2,700,000 | 13,600 | 10,300 |
| 3 | 372,000 | 398,000 | 910 | 2,710 |
| 4 | 22,050,000 | 27,720,000 | 20,400 | 44,000 |
| 5 | 15,120,000 | 22,720,000 | 37,900 | 64,600 |
| 6 | 18,900,000 | 23,360,000 | 41,800 | 59,400 |
| 7 | 134,000 | 142,000 | 7,560 | 11,300 |
| 8 | 434,000 | 99,000 | 2,330 | 5,800 |
| 9 | 300,000 | 321,000 | 7,600 | 9,800 |
| 10 | 540,000 | 1,950,000 | 11,800 | 18,800 |
| 11 | 970,000 | 1,040,000 | 46,000 | 69,300 |
| 12 | 540,000 | 403,000 | 4,890 | 5,720 |
| 13 | 14,900,000 | 21,400,000 | 9,800 | 9,900 |
| 14 | 17,800,000 | 15,000,000 | 8,900 | 15,800 |
| 15 | 1,140,000 | 1,160,000 | 1,560 | 2,320 |
| 16 | 1,060,000 | 600,000 | 1,010 | 1,200 |
| 17 | 8,600,000 | 7,000,000 | 15,000 | 31,500 |
| 18 | 12,400,000 | 18,000,000 | 9,700 | 15,300 |
| 19 | 105,000,000 | 113,000,000 | 17,500 | 16,100 |
| 20 | 2,700,000 | 3,270,000 | 8,800 | 11,700 |
| 21 | 410,000 | 1,040,000 | 1,170 | 4,150 |
| 22 | 19,800,000 | 11,800,000 | 41,000 | 86,000 |
| 23 | 90,000,000 | 25,200,000 | 5,800 | 15,800 |
| 24 | 15,900,000 | 23,000,000 | 18,200 | 33,000 |
| 25 | 91,000,000 | 11,600,000 | 14,400 | 14,800 |
| 26 | 16,800,000 | 9,000,000 | 85,000 | 156,000 |
| 27 | 14,600,000 | 1,300,000 | 468,000 | 227,000 |
| 28 | 28,200,000 | 7,560,000 | 127,000 | 280,000 |
| 29 | 5,400,000 | 8,100,000 | 36,600 | 68,000 |
| 30 | 12,200,000 | 800,000 | 33,300 | 34,500 |
| 31 | 98,000,000 | 21,800,000 | 28,200 | 40,600 |
| 32 | 1,780,000 | 1,030,000 | 26,500 | 31,300 |
| 33 | 4,540,000 | 1,370,000 | 9,500 | 34,600 |
| 34 | 15,600 | 37,200 | 300 | 110 |
| 35 | 9,300 | 8,700 | 90 | 270 |
| 36 | 9,800 | 3,000 | 100 | 60 |
| 37 | 143,000 | 43,800 | 765 | 730 |
| 38 | 162,000 | 105,000 | 8,400 | 8,200 |
| 39 | 18,700 | 11,000 | 1,340 | 1,580 |
| 40 | 6,060,000 | 3,460,000 | 30,100 | 34,300 |
| 41 | 25,900 | 18,700 | 830 | 1,160 |
| 42 | 6,480,000 | 4,680,000 | 24,000 | 26,000 |
| 43 | 15,200 | 11,200 | 334 | 190 |
| 44 | 118,000 | 137,000 | 9,000 | 6,100 |
| 45 | 9,900 | 3,530 | 320 | 20 |
| 46 | 119,000 | 120,000 | 20,800 | 21,100 |
| 47 | 19,900 | 31,000 | 62 | 172 |
| 48 | 137,000 | 203,000 | 3,100 | 2,600 |
| 49 | 5,300 | 2,930 | 34 | 152 |
| 50 | 127,000 | 118,000 | 80 | 4,800 |

TABLE 3.—*Total counts using commercial market milk, raw and pasteurized. Plates incubated at 30° C. for 6 days.*

| Sample No. | Commercial raw milk. | | Sample No. | Commercial pasteurized milk. | |
|---|---|---|---|---|---|
| | Infusion agar. | Casein-agar. | | Infusion agar. | Casein-agar. |
| 1 | 2,450,000 | 2,250,000 | 1 | 246,000 | 600,000 |
| 2 | 63,500,000 | 68,400,000 | 2 | 321,000 | 307,000 |
| 3 | 2,930,000 | 2,950,000 | 3 | 154,000 | 213,000 |
| 4 | 1,040,000 | 1,500,000 | 4 | 22,500 | 26,400 |
| 5 | 6,700 | 13,600 | 5 | 13,100 | 22,500 |
| 6 | 2,560 | 3,980 | 6 | 123,000 | 200,000 |
| 7 | 277,000 | 276,000 | 7 | 35,200 | 59,500 |
| 8 | 298,000 | 163,000 | 8 | 351,000 | 368,000 |
| 9 | 186,000 | 262,000 | 9 | ..... | ..... |
| 10 | 204,000 | 208,000 | 10 | ..... | ..... |
| 11 | 630,000 | 383,000 | 11 | ..... | ..... |

TABLE 4.—*Comparison of total counts on litmus-lactose-gelatin and casein-agar. Plates incubated at 18° C. for 6 days.*

| Litmus-lactose-gelatin. | Casein-agar. |
|---|---|
| 59,000 | 228,000 |
| 31,500 | 201,000 |
| 19,100 | 10,500 |
| 14,600 | 30,800 |

TABLE 5.—*Comparison of the bacterial groups in milk which grow on casein-agar and infusion agar plates.*

| Quality of milk. | Raw milk. | | | Same milk pasteurized. | |
|---|---|---|---|---|---|
| | Bacterial groups. | Infusion agar. | Casein-agar. | Infusion agar. | Casein-agar. |
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Good..... | Acid, coagulating..... | 33.85 | 9.90 | 11.85 | 3.19 |
| | Acid..... | 6.85 | 7.94 | 61.25 | 34.57 |
| | Inert..... | 43.13 | 63.79 | 22.06 | 49.74 |
| | Alkali..... | 3.33 | 5.90 | 0.36 | 2.99 |
| | Peptonizing..... | 12.81 | 12.44 | 4.47 | 9.49 |
| Medium... | Acid, coagulating..... | 12.98 | 8.45 | 31.89 | 18.73 |
| | Acid..... | 9.74 | 7.18 | 34.87 | 29.72 |
| | Inert..... | 43.51 | 50.09 | 24.00 | 40.63 |
| | Alkali..... | 19.66 | 17.79 | 5.63 | 7.92 |
| | Peptonizing..... | 14.10 | 16.47 | 3.59 | 2.99 |
| Poor..... | Acid, coagulating..... | 36.17 | 19.51 | 17.91 | 15.12 |
| | Acid..... | 10.71 | 12.12 | 61.87 | 51.95 |
| | Inert..... | 29.31 | 32.99 | 9.06 | 15.98 |
| | Alkali..... | 6.47 | 17.58 | 9.77 | 15.73 |
| | Peptonizing..... | 17.31 | 17.77 | 1.39 | 1.20 |

TABLE 6.—*Comparison of bacterial groups in ripened cream and butter which grow on casein-agar and lactose-agar.*

| Material. | Bacterial groups. | Casein-agar, 183,000,000 bacteria per c. c. | Lactose-agar, 2,180,000,000 bacteria per c. c. |
|---|---|---|---|
| | | *Per cent.* | *Per cent.* |
| Ripened cream | Acid, coagulating | 67.45 | 71.19 |
| | Acid | 0.79 | 1.69 |
| | Inert | 0.00 | 24.58 |
| | Alkali | 0.00 | 0.00 |
| | Peptonizing | 31.75 | 2.54 |
| Butter, unwashed and unsalted | Acid, coagulating | 37.50 | 92.72 |
| | Acid | 35.00 | 1.71 |
| | Inert | 2.50 | 2.57 |
| | Alkali | 10.00 | 0.00 |
| | Peptonizing | 15.00 | 0.00 |
| | | 14,200,000 bacteria per gram. | 24,900,000 bacteria per gram. |
| Butter, unwashed and salted | Acid, coagulating | 37.34 | 88.37 |
| | Acid | 32.00 | 8.14 |
| | Inert | 2.67 | 2.33 |
| | Alkali | 18.66 | .... |
| | Peptonizing | 9.33 | 1.16 |
| | | 17,600,000 bacteria per gram. | 21,800,000 bacteria per gram. |
| Butter, washed and salted | Acid, coagulating | 42.71 | 88.69 |
| | Acid | 20.83 | 3.48 |
| | Inert | 5.22 | 7.83 |
| | Alkali | 13.54 | 0.00 |
| | Peptonizing | 17.70 | 0.00 |
| | | 23,500,000 bacteria per gram. | 33,600,000 bacteria per gram. |
| Butter, washed and unsalted | Acid, coagulating | 46.67 | 91.58 |
| | Acid | 20.00 | 6.32 |
| | Inert | 4.44 | 2.10 |
| | Alkali | 15.55 | 0.00 |
| | Peptonizing | 13.34 | 0.00 |

TABLE 7.—*Determination of peptonizing bacteria by various methods.* (*Raw milk.*)

| Casein-agar plates flowed with N/10 lactic acid. | Tube method, casein-agar plates. | | Tube method, infusion agar plates. |
|---|---|---|---|
| 6 days' incubation, 30° C. | 5 days' incubation, 30° C. | 14 days' incubation, 30° C. | 14 days' incubation, 30° C. |
| 400,000 | 700,000 | 1,300,000 | 100,000 |
| 600,000 | 700,000 | 1,000,000 | 200,000 |
| 80,000 | 70,000 | 80,000 | [1] 0 |
| 1,100,000 | 2,300,000 | 2,300,000 | 4,000,000 |
| 1,600,000 | 1,400,000 | 1,700,000 | 1,800,000 |
| 600,000 | 760,000 | 780,000 | 650,000 |
| 110,000 | 130,000 | 140,000 | 180,000 |
| 1,100,000 | 1,000,000 | 1,200,000 | 1,700,000 |
| 500,000 | ..... | ..... | 300,000 |
| 2,900,000 | 2,600,000 | 2,600,000 | 1,400,000 |
| 300,000 | ..... | ..... | 1,100,000 |
| 600,000 | 200,000 | 300,000 | 900,000 |
| 300,000 | 300,000 | 300,000 | 300,000 |
| 190,000 | 200,000 | 200,000 | 260,000 |
| 200,000 | ..... | ..... | 100,000 |
| 800,000 | 1,500,000 | 1,700,000 | 1,600,000 |
| 130,000 | 130,000 | 190,000 | 170,000 |
| 130,000 | 270,000 | 400,000 | 620,000 |
| 800,000 | 600,000 | 800,000 | 700,000 |
| 70,000 | 660,000 | 680,000 | 240,000 |
| 1,200,000 | 1,300,000 | 1,300,000 | ..... |
| 20,000 | 50,000 | 80,000 | 40,000 |
| [2] 0 | [2] 0 | 2,000,000 | 200,000 |
| 70,000 | 80,000 | 100,000 | ..... |
| 600 | 500 | 900 | 100 |
| 100 | 500 | 800 | 1,500 |
| 100 | [3] 0 | [3] 0 | 200 |
| 400 | 300 | 400 | 300 |
| 1,200 | 100 | 500 | 1,100 |
| 20,000 | 30,000 | 60,000 | ..... |
| 100 | [3] 0 | 700 | 700 |
| 90 | 90 | 170 | 800 |

[1] Dilution, $\frac{1}{10,000}$. [2] Dilution, $\frac{1}{1,000,000}$. [3] Dilution, $\frac{1}{100}$.

TABLE 8.—*Determination of peptonizing bacteria by various methods. (Pasteurized milk.)*

| Casein-agar plates flowed with N/10 lactic acid. | Tube method, casein-agar plates. | | Tube method, infusion agar plates. |
|---|---|---|---|
| 6 days' incubation, 30° C. | 5 days' incubation, 30° C. | 14 days' incubation, 30° C. | 14 days' incubation, 30° C. |
| 500 | [1] 0 | [1] 0 | 400 |
| 100 | [2] 0 | 100 | 300 |
| 30 | 10 | 20 | ..... |
| 600 | [1] 0 | 500 | 400 |
| 1,700 | [1] 0 | 900 | [1] 0 |
| 200 | 200 | 200 | 500 |
| 30 | 20 | 20 | 30 |
| 300 | 200 | 300 | [1] 0 |
| 200 | [1] 0 | 100 | [1] 0 |
| 300 | 100 | 100 | 200 |
| [2] 0 | [2] 0 | [2] 0 | [2] 0 |
| [2] 0 | [2] 0 | 0 | 5,000 |
| [2] 0 | [2] 0 | 2,000 | 1,000 |
| 400 | ..... | ..... | 400 |
| 300 | ..... | ..... | 200 |
| [1] 0 | [1] 0 | [1] 0 | ..... |
| [1] 0 | 20 | 40 | ..... |
| 500 | [1] 0 | 100 | ..... |
| 100 | [1] 0 | [1] 0 | 100 |
| 100 | 200 | 300 | [1] 0 |
| [1] 0 | [1] 0 | [1] 0 | ..... |
| [1] 0 | 200 | 200 | [1] 0 |
| 1,000 | [2] 0 | [2] 0 | [2] 0 |
| [1] 0 | [1] 0 | [1] 0 | 100 |
| [1] 0 | [1] 0 | [1] 0 | [1] 0 |
| [1] 0 | [1] 0 | 100 | 1,700 |
| 300 | 100 | 100 | [1] 0 |
| 200 | [1] 0 | [1] 0 | ..... |
| 10 | [3] 0 | 10 | 10 |
| 10 | [3] 0 | [3] 0 | [3] 0 |
| 10 | 10 | 10 | ..... |
| 120 | [3] 0 | 240 | 200 |
| 150 | [3] 0 | 10 | [3] 0 |
| 1,500 | 100 | 200 | 1,200 |
| 150 | [3] 0 | 20 | [1] 0 |
| 800 | [1] 0 | 200 | 1,000 |
| [1] 0 | [1] 0 | [1] 0 | [1] 0 |
| 800 | 200 | 400 | 10 |

[1] Dilution, $\frac{1}{100}$.
[2] Dilution, $\frac{1}{1,000}$.
[3] Dilution, $\frac{1}{10}$.

# THE CONTROL OF BULK MILK IN STORES.

By ERNEST KELLY,
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## INTRODUCTION.

It has been a too prevalent custom in the past to lay all of the blame for dirty milk upon the shoulders of the milk producer. While this may be an easy and convenient way to shift the burden of responsibility from city to country, still it is apt not only to hurt the dairy industry unfairly, but to close the eyes of reformers and health authorities to questions that lie nearer home. It is easy to cry out against the dairy farmer who lives at a distance, at the same time ignoring near-by methods which may serve to make the milk more dangerous than does the contamination received at the farm. Dairy inspection, to be complete and effective, must not only safeguard the points of production, but must closely follow the product in its subsequent journey until finally it is consumed.

The Department of Agriculture has realized the importance of this question and has published a score card for city milk plants, endeavoring to inaugurate a careful inspection of them by local authorities. It has been found, however, that many cities stop in their inspection work when the milk has passed through the city plant and been prepared for delivery. In comparatively few localities is there a systematic efficient method for the control of milk-selling stores. These stores are usually groceries, entirely unfitted for handling milk. They possess, in general, no proper receptacle for icing and storing milk; they are not equipped with efficient means of cleaning and sterilizing the utensils used in measuring; they are usually located in congested districts, among the poorer class of consumers, and are often conducted by ignorant and careless proprietors. As a city grows in size and the congestion is greater, this problem assumes greater proportions, not only because the number of milk-selling stores is larger, but because increased congestion means lessened vitality in the children and a consequent need of purer milk.

To ascertain the extent of store trade in milk, the following set of questions was sent out to 47 of the largest cities in this country:

1. About how many stores (groceries, etc.) sell milk in your city?
2. What proportion sell bottled milk?
3. About how many gallons of dipped milk are sold daily from such stores?

4. What regulations have you governing stores that sell milk?
5. Do you have much difficulty with such stores?
6. How often are such stores inspected?
7. Have you any figures showing bacterial counts of dipped store milk as compared with wagon milk or bottled milk?
8. Do you consider dipped store milk to be a serious problem in your city?

## EXTENT OF STORE-MILK TRADE.

During recent years the proportion of bottled milk consumed has greatly increased, and it is rather surprising to note the amount of bulk milk still used. The cities reporting had an average population of 451,239, or about the same as Detroit, Mich. These cities averaged 1,256 milk-selling stores, or one for every 359 inhabitants. Of these stores, 52.4 per cent sold only bottled milk, while the remainder, 47.6 per cent, dealt in bulk milk. The amount of bulk milk sold over the counter amounted to 231,896 gallons a day in 17 cities reporting. This is 13,641 gallons a day in each city allowing the practice, and 0.165 pint a day for every inhabitant—men, women, and children. This means that a cylinder 6 feet in diameter and 64½ feet high could be filled daily in each of these average cities with milk which is dipped, poured, or handled over in the poorly equipped, often filthy, corner grocery store. These figures are enough to convince one as to the magnitude of this question. Add to the amount of bulk milk the conditions under which most of it is handled, and the fact that much of it is fed to children already weakened in vitality by overcrowding, underfeeding, and lack of intelligent care, and the problem assumes a serious aspect.

## PRESENT MUNICIPAL CONTROL.

As evidenced by the replies to the questions sent out, methods for the control of store milk vary greatly in different cities. Some localities apparently pay no attention whatever to the problem, others require that the milk sold must "come up to standard," while a very few seem to carry on a fairly regular, efficient, sanitary inspection. Only four cities reported a score card in use for stores. Sixteen and two-thirds per cent of all the cities answering had no inspection at all, or at best a sporadic, irregular inspection. The cities reporting regular systems averaged 13 inspections a year, or about 1 a month. Bottled milk only is permitted to be sold in some cities, and this has had the effect of greatly improving conditions. As has already been mentioned, over half of the milk-selling stores now handle exclusively the bottled product.

An analysis of the laws for the control of stores shows in many cases that the subject has been sadly neglected. Some lawmakers have apparently believed that the issuance of a "permit" or "license" by the board of health, for the trifling consideration of a

dollar or so, would serve as an effective talisman against all the dangers of impure milk. What matter if no inspector ever crosses the threshold of the "licensed" milk store, so long as the fee is collected. More progressive cities demand that store milk be kept under certain sanitary conditions, and that it must conform to definite chemical and bacteriological standards. It is encouraging now and then to find clear, concise regulations such as these: "Clean all measures and scald them daily with boiling water." "The ice box or ice tub in which milk * * * is kept must be thoroughly cleaned by scrubbing at least twice a week."

Here, then, are two classes of cities in which there is no adequate control of store milk. One class comprises those cities which have no ordinance requiring an inspection of stores; the other class, cities having laws covering the subject, but where, either through inefficiency or ignorance, such laws are not enforced. There is still another class where the laws exist and the good intentions exist, but where no financial means have been provided for the execution of the regulations. The sad plight of such a town is aptly described by the board of health of a city of 100,000, who write: "Have the regulations in the code, but no appropriation to carry them out. Have tried for several years to have all milk and sources of supply regularly inspected, but have not succeeded as yet."

## DISADVANTAGES OF BULK STORE MILK.

To one who has made even a cursory examination of the subject the disadvantages of the practice of dipping milk are obvious. They are chiefly of two classes, chemical and bacteriological. The chemical composition is important, but should be considered as secondary to the cleanliness and healthfulness of the product. The skimming or watering of milk is usually a deliberate fraud, and as a result the consumer gets a lesser value for the money expended. On the other hand, bacterial contamination often takes place through ignorance, and its results are far more dangerous to health.

No matter how bulk milk is handled, there is always the likelihood (aside from premeditated adulteration) that some customers will be served at the expense of others. If the milk is ladled out of a can, the top layer containing much of the cream is liable to be used first, leaving the skim milk for later buyers. If a storage tank with a faucet is used, the process is reversed and the skim milk is drawn first. Whether or not the fraud is intentional, the wrong is done, and the customer has no way of seeing the amount of cream on the milk, as he may do if the fluid is in a glass bottle. The health department of one large city writes that a chemical analysis of store milk shows from 5 to 10 per cent of it to be watered. They do not say how much more was skimmed. The chief milk inspector of

Detroit says: "In addition to the sanitary defects of bulk milk in stores, we found that 20 per cent of the samples taken therefrom were adulterated."

Turning now to the dangers from bacterial contamination, we are confronted by the most serious aspect of the problem. Every pair of hands through which milk must pass adds to the danger of its contamination. The hands of the corner groceryman are not always clean, nor do they always find within reach proper facilities for handling milk. Another condition adverse to store milk is the fact that those who handle it, as a rule, do not understand or care about the principles underlying its proper handling. We expect and require that dairymen and managers of milk plants should have some knowledge regarding the product with which they deal, but we allow gross ignorance and carelessness to creep in farther along the line. The small grocer keeps milk usually as an accommodation to his customers and not for any revenue it may bring in. Since this is so, he dislikes any extra trouble connected with the distribution of such a perishable article of trade.

## BACTERIAL CONTAMINATION IN STORES.

It is a well-established fact that bulk store milk generally contains many more bacteria than does milk delivered from house to house by the dairyman. Many of the largest cities in the country either do not seem to realize the importance of this phase of the milk question, or else they are content to accept the statement without attempting to test its truth in their own cases.

Of the 43 cities from which replies were received to the question "Have you any figures showing bacterial counts of dipped store milk as compared with wagon milk or bottled milk?" 35, or over 81 per cent, answered "No." Five cities made the general statement that dipped store milk ran much higher in bacteria than wagon milk, but gave no results of experiments which would support the statement conclusively. One city officer says: "We have decided that the bacteriological examination of milk taken from cans in the stores is useless, because milk taken from vessel of customers has always shown a much higher count." Another, in a city of over 300,000 population, writes: "We make no bacterial counts." Three cities—Boston, Mass., Newark, N. J., and St. Paul, Minn.—gave bacterial counts which are well worth summarizing.

Boston figures for 1908–9 show:

| | Per cent. |
|---|---|
| Samples of wagon milk containing over 500,000 bacteria per cubic centimeter. | 27. 85 |
| Samples of store milk containing over 500,000 bacteria per cubic centimeter. | 56. 59 |

For 1909–10:

| | |
|---|---|
| Samples of wagon milk containing over 500,000 bacteria per cubic centimeter. | 24. 61 |
| Samples of store milk containing over 500,000 bacteria per cubic centimeter. | 45. 26 |

These results were obtained from a large number of analyses and should be considered a fair average.

St. Paul, Minn., gives the results of a good number of bacteriological examinations, and these summarized give the following figures:

Wagon milk, average count 409,477 bacteria per cubic centimeter.
Dipped store milk, average count 8,206,000 bacteria per cubic centimeter.

This shows an increase of about 1,904 per cent in bacteria from the milkman's wagon to the consumer's table by way of the dipped-milk shop.

Newark, N. J., contributes some figures which confirm the foregoing figures. An average of the results reported by this city shows:

Bottled wagon milk, 416,000 bacteria per cubic centimeter.
Dipped wagon milk, 3,623,333 bacteria per cubic centimeter.
Milk delivered to store, 28,800 bacteria per cubic centimeter.
Same milk, 8 hours later, 1,488,000 bacteria per cubic centimeter.

The question naturally arises as to the reasons for this much higher bacterial count in the bulk store milk. There are two main reasons—contamination and lack of proper refrigeration during storage. To these reasons might be added another—that often milk of the poorest grade is set aside by unscrupulous dealers for delivery to stores. This milk may be delivered sweet to the store, and if it later sours on the consumer's hands the fault will be laid to the storekeeper instead of the dealer. Such milk could not be bottled and put out on the retail wagons without causing a considerable loss of trade through dissatisfied customers.

The very nature of the surroundings in the average store makes for the easy contamination of bulk milk. We insist that milk handling stations shall be kept free from rubbish, and even go so far as to advise that in constructing such buildings all unnecessary ledges and dust catching projections be avoided. In the grocery store, however, far different conditions are sometimes found: shelves filled with goods which form myriad nooks and corners for the collection of dust; tubs of rubbish and refuse; kerosene, onions, cabbage, and other odoriferous articles; mice, roaches, and sometimes other vermin at large; people passing in and out, stirring up the dust and tracking street filth into the store; flies, numerous and busy, passing and repassing between the milk cans or dippers and nearby spittoons and garbage barrels. And in the midst of all this, a can of milk—sometimes covered, sometimes not—ladled and poured, dipped and stirred, and finally carried away for baby's breakfast.

In most of the smaller and poorer stores part of the building is used for the owner's residence. Sometimes the living room opens directly into the salesroom, and the danger from infection is serious when there is illness in the family. If there are children, they run

in and out between the house and the store. The chief milk inspector in a city of some size is authority for the statement that he has seen a child playing in a store pick up a handful of dirt from the floor, toddle to an open can, and empty the filth into the milk.

Another serious factor in the sale of bulk milk in stores is the lack of care in cleaning the utensils. Dippers and measures sometimes go for days at a time unwashed, and the old milk left in the seams and crevices provides an ideal breeding place for bacteria. Even though the utensils may be apparently clean, they may not be bacteriologically clean. Ultimate cleanliness can not be secured except by boiling or steaming, and this is seldom done in the average store.

The direct contact with dirty attendants is often another cause of contamination. Dirty hands are smeared on the dipper or the storage can, and in measuring out a customer's purchase the pitcher or other receptacle is carefully held over the open can, so that if any milk runs down over the salesman's hands it will not be wasted.

After contamination has occurred, bacterial growth is greatly accelerated by improper refrigeration. The multiplication of organisms in warm milk takes place at a rapid rate, and milk which was originally of fair quality may soon become unfit for use if not stored at a low temperature. Under store conditions refrigeration is often most unsatisfactory and inefficient. Sometimes the can of milk is left by the dealer outside the door, where it stands in the dust and heat until the store is opened in the morning. Even after the can is taken into the store, it often stands around for some time before being placed on ice. Perhaps the iceman is late, or his supply is exhausted before the store is reached. Then, too, ice is an expensive luxury in some of the tenement districts, and the tendency is to make a small quantity do an impossible amount of work, with the result that the milk is left without proper refrigeration before the day is over.

## SUGGESTED MEANS OF CONTROL.

That dipped store milk is a problem in many large cities is shown by the answers to the questions to which reference has already been made. Twenty-one cities where dipped milk is sold reported, and of this number 7, or 33⅓ per cent, reported much trouble with milk stores. As the amount of dipped milk sold increases, the gravity of the situation also increases. This is confirmed by a close inspection of the answers to the question, "Do you consider dipped store milk to be a serious problem in your city?" The cities answering "No" averaged only 37.37 per cent of dipped milk, while those answering "Yes" averaged 63.81 per cent.

It is a far easier matter to point out defects than it is to suggest efficacious remedies. It is also easy to formulate drastic procedures

for a cure, but we must be careful that the surgeon's knife, in excising a diseased area, does not cut too deep and inflict a mortal wound. While it is possible in some localities to allow only bottled milk to be sold, still there are other cities where it is impracticable to abolish the system at once. It must be admitted that bottling adds to the cost of the finished product, and as the dealer will not pay the increase, it reacts on the consumer. If the consumer is able to pay this increase, well and good; but if not, the logical result will be that the use of this valuable food product will be seriously curtailed. Another reason for the tolerance of bulk milk under certain conditions is this: Many poor families in the overcrowded tenement districts buy only one or two cents' worth of milk at a time. Even if it were possible for this class of people to buy a whole bottle at a time, there would be no means of keeping it cold in most of the homes. So, then, we must be able to enforce a system which will allow the poor consumer to buy a reasonably priced milk in quantities small enough for immediate use; and, moreover, this milk must not only be carefully produced, but it must be carefully handled in the city.

Since bulk milk will be allowed for the present, at least, in some cities, it is well to consider how it may best be controlled. First of all, a regular system of inspection for stores should be established. Inspections should take place at least once a month, and where very bad conditions exist weekly visits should be made until a better state of affairs is found. To keep accurate account of all milk-selling stores, it is best to require a permit; this permit should be issued free of cost if possible, but at any rate the financial value of the permit should be made subordinate to its worth as a record and a guide to inspection.

### THE SCORE-CARD SYSTEM OF INSPECTION.

Experience in sanitary inspection has taught that there is no system so efficient as the use of the score card. This method of inspection takes cognizance of every condition, and the finished score gives an accurate record of the minutest details. The record thus formed is a much more reliable estimate of conditions than is a mere survey unaided by the score card; also, the completed score serves as a permanent record to be filed in the office, to be used as a future reference and guide. The work of securing improved sanitary conditions is largely a work of education; the score card forms an ideal textbook, containing as it does an observation of each condition, rated mathematically according to its importance.

In the work of the Dairy Division score cards have been used for some time in rating sanitary conditions connected with the production, handling, and distribution of milk. Realizing the need of still

further inspection, a score card has been worked out for stores where bulk milk is handled. This card, which is reproduced on next page, follows the general form which has been found successful in other score cards. Items of equipment and methods have been separated, and the greatest credit is allowed for methods; thus a premium is put upon care and vigilance rather than upon expensive construction and appliances.

It is important, in formulating a score card, to avoid items which are indefinite and those which allow great latitude of judgment by an inspector. The main points on the card should be so divided into subheads that the verdict of different inspectors can not vary greatly. On the score card used by one city appears the item: "Cleanliness of store and its surroundings, 20." Here are one-fifth of the total points in the score given under one head, without any specification of the different details contributing to the general cleanliness. The judgment of two different inspectors might easily vary 10 points under so general and indefinite a classification.

The score card should be regularly used in inspection work among stores, and it is believed that it will do much to improve conditions.

The Dairy Division score card for stores handling bulk milk is as follows:

[Front of card.]

[United States Department of Agriculture, Bureau of Animal Industry, Dairy Division.]

SANITARY INSPECTION OF STORES HANDLING BULK MILK.

Operator: ———. Address: ———. Gallons sold daily: ———. Permit No. ———. Date: ———. Remarks: ———.

(Signed) ———————, *Inspector.*

[Back of card.]

DETAILED SCORE.

| Equipment. | Score. Perfect. | Score. Allowed. | Methods. | Score. Perfect. | Score. Allowed. |
|---|---|---|---|---|---|
| Building: | | | Building: | | |
| Location: Free from contaminating surroundings | 2 | ..... | Cleanliness | 10 | .... |
| Separate room for milk handling | 5 | ..... | Floor | 3 | |
| Construction | 8 | ..... | Wall | 2 | |
| Floors, tight, smooth, cleanable | 1 | | Ceiling | 2 | |
| Walls tight, smooth, cleanable | 1 | | Show cases, shelves, etc | 3 | |
| Ceilings, tight, smooth, cleanable | 1 | | Freedom from flies | 3 | .... |
| Show cases smooth, free from ledges and crevices | 1 | | Freedom from rubbish | 2 | .... |
| Provision for light (10 per cent of floor space) | 1 | | Air | 4 | .... |
| Provision for pure air | 1 | | Freedom from dust | 2 | |
| Screens | 2 | | Freedom from odors | 2 | |
| Utensils | 15 | ..... | Utensils | 20 | .... |
| Construction: Easily cleaned; free from open seams and complicated parts | 5 | | Thoroughly washed and rinsed | 10 | |
| Condition: Free from rust, dents, etc. | 2 | | Steamed | 10 | |
| Facilities for cleaning: | | | (Scalded, 5.) | | |
| Water clean, convenient, and abundant | 2 | | Ice box: | | |
| Hot water or steam | 3 | | Cleanliness of ice box | 3 | |
| Brushes and washing powder | 1 | | Handling: | | |
| Protected from flies and dust when not in use | 2 | | Placed on ice as soon as received | 5 | .... |
| Ice box | 10 | ..... | (Protected, put on ice inside of an hour, 2.) | | |
| Separate ice box for milk | 5 | | (Unprotected, but put on ice inside of an hour, 1.) | | |
| (Milk kept in separate compartment, 2.) | | | Temperature of milk, below 50° F. (51–55, 8; 56–60, 5; 61–65, 2) | 10 | .... |
| Construction | 3 | | Freedom from undue exposure to air | 2 | .... |
| Tight and cleanable | 1 | | Cleanliness of attendants | 1 | .... |
| Nonabsorbent lining | 1 | | | | |
| Good drainage | 1 | | | | |
| Protected from flies and dust | 2 | | | | |
| Total | 40 | ..... | Total | 60 | .... |

Equipment ..... + Methods ..... = Total.....

NOTE.—If the conditions in any particular are so exceptionally bad as to be inadequately expressed by a score of "0," the inspector can make a deduction from the total score.

## ULTIMATE RESULTS OF INSPECTION.

A scoring of all the stores handling milk will result in a list definitely classified as to conditions found. Then a minimum score standard can be set which will cause some of the worst stores to improve or else stop handling milk. This minimum standard can be gradually raised as conditions improve, always leaving a few stores below the required mark. The result will be that quite a number of storekeepers will stop the sale of milk rather than make the effort to improve. No regret need be felt over this, as it will mean the elimination of the most careless and ignorant class.

Probably the ideal system for store milk (if bottled milk is not practicable) is to have a few central distributing stations. In these stations only milk would be dispensed, and a high standard of cleanliness could be maintained; they could be operated, under municipal control, by milk dealers or by a corporation as a business proposition. Such stations could afford superior equipment and a better class of labor than could be secured by storekeepers who handle only a few quarts a day. Already in some cities this plan is being used, but usually the effort is sustained by contributions and is able to reach only a small proportion of the babies. What is needed is a system which will be self-supporting and permanent and which will safeguard every drop of milk sold over the counter.

Perhaps this system of central milk-distributing stores is idealistic, but it is believed that the careful and persistent use of the score card in inspection will tend toward this result by eliminating many of the careless dealers. Gradually it will come about that milk will be handled by fewer stores, stores that can afford better equipment and where the supervision is more intelligent.

This change will take place without the danger of friction that would follow a more drastic ordinance. Reforms must stand the test of practicability before they can be of any use. The milk problem is an enormous one, which can not be solved at once, and we should strive always for a gradual, healthy growth.

# NOTES ON THE POULTRY AND EGG INDUSTRY IN THE UNITED STATES.

By HARRY M. LAMON,
*Junior Animal Husbandman, Animal Husbandry Division.*

There has been a very marked growth and improvement in the poultry and egg industry in the United States during recent years. The industry has progressed in every way, and is now gradually taking its place as one of the leading agricultural industries of the country. Secretary Wilson, of this department, estimates the value of poultry products for 1910 at about $750,000,000, which figure compares favorably with the estimated values of the cotton, hay, or wheat crops for the same year. With this growth in the volume of poultry products there has been an even greater proportionate improvement during recent years in the methods of production and marketing, notably in the establishment of poultry-breeding farms and the placing of poultry breeding on a recognized plane, while at the same time educational and experimental work in poultry has been established or greatly increased throughout every section of the United States.

The bulk of the poultry products is produced in the great agricultural or crop-producing States, which means that it is produced on the farm and by the farmer. Poultry raising, however, is usually considered of small importance by the general farmer, and not worthy of much attention or of any particular investment. Therefore there is a great need of improvement in the care and management of poultry and in the production and marketing of eggs. It is only during the past few years that the average farmer has realized the necessity for careful management in this direction. This is gradually being brought to his attention by the various organs of educational poultry work, as well as by the campaigns of education and inspection which have been instituted by pure-food inspectors and State boards of health. Improved methods on the farms will result in a great improvement in poultry products, as the farms are the source of greatest production.

## VALUE AND INCREASE DURING LAST TEN YEARS.

Preliminary reports from the census of 1910, including 35 States, which are all the figures available at the time this paper is written, show an increase of 106.3 per cent in the value of poultry products in the extreme Western States during the past 10 years; of 102.3 per cent in the Southwestern States; of 66.6 per cent in the Middle

Western States; of 59.3 per cent in the Southeastern States, and of 54.5 per cent in the Northeastern States. These figures show in a general way the comparative increase in the different sections of the country, although the data for the remaining States will probably change the percentages slightly. The Middle West still leads as the center of the greatest production, but the growth in the Far West and in the South is very marked. The figures for the South show that the poultry industry in that section of the country is receiving a great deal of attention. The improvement in the methods of production and marketing are giving this section an important place among the great poultry producing and shipping sections of the country.

The gradual rise in the price paid to the farmer for poultry products during the past 10 years has given him some incentive to adopt better methods of production and marketing. On the other hand the low prices received during the seasons of greatest production and of high temperatures, or in sections where the transportation or marketing facilities have not been well developed, offer a very great obstacle to more careful methods. Figures compiled from the market reports of New York City show that the average wholesale price of eggs increased from 17.5 cents a dozen in 1900 to 25.5 cents in 1909, while the receipts increased from 2,912,000 to 4,112,000 cases during the same period.

## THE EXCLUSIVE POULTRY AND EGG FARM.

Poultry is reared under a great variety of conditions, from the small suburban poultry yard or farm which supports only a few hens to the large poultry plant or poultry farm where thousands of hens are kept and poultry is the only source of income. Such large plants or farms are scattered throughout the entire country, but are found in greater numbers in the North Atlantic States, including New England, and in the States directly west of this section. The growth of these farms has spread rapidly westward during the past few years. Such a farm is shown in Plate XXXI.

The prices received for breeding stock and eggs during recent years offer considerable encouragement to the establishment of these large breeding farms, and such ventures are beginning to attract capital from many different sources. The success of the mammoth incubators and the improvements which have been made in brooding chickens under the pipe system have helped to make the large poultry farms successful, giving them the opportunity to handle a larger volume of business. Besides the trade in breeding stock and eggs for hatching, the selling of day-old chicks has developed very rapidly. Moreover, chickens as well as eggs and breeding stock have been shipped several thousand miles successfully. All of these factors have helped to make large poultry-breeding plants successful.

AN EXCLUSIVE POULTRY FARM.
Ducks and duck sheds in the background.

FIG. 1.—A VILLAGE STORE, SHOWING BAD CONDITIONS IN THE HANDLING OF POULTRY AND EGGS.

FIG. 2.—VIEW OF A MODERN POULTRY PACKING ROOM.

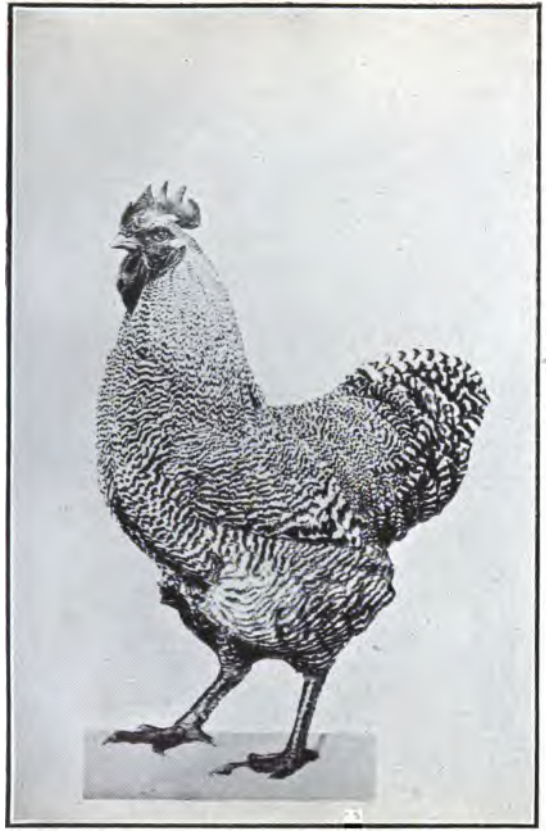

FIG. 1.—A TYPICAL GENERAL-PURPOSE FOWL—BARRED PLYMOUTH ROCK MALE.

FIG. 2.—A FOWL OF A STRICTLY EGG-LAYING BREED—WHITE LEGHORN MALE.

UNIV. OF MICH.

Most of the earlier poultry plants or farms were started primarily to raise poultry products for the market, but the object of most of the farms established recently has been to raise poultry and eggs for sale as breeders or for hatching, as well as for the market. In fact, nearly all these farms at the present time have taken up the combination—selling breeding stock, eggs for hatching, and day-old chicks—as well as market poultry products, until it is difficult to find large poultry plants devoted entirely to the production of poultry and eggs for the market. The proprietors of these farms evidently found the combination more profitable, and consequently the greatest growth has been in this direction. However, a few strictly market plants still exist and appear to be quite successful. These plants are more numerous and apparently more successful when operated as special branches of poultry farming, such as duck plants, "soft-roaster" farms, and those engaged in the exclusive production of capons or milk-fed poultry, or in general, farms where a specialty is made of producing products which do not compete directly with those raised on the general farm.

The present situation favors the establishment of strictly poultry plants, where products, although produced at a greater cost than on the general farm, nevertheless allow the producer a larger share of the middleman's profit, chiefly because the marketing is more direct. Exclusive poultry farms are generally located near the consumers of their products. These products are raised and marketed under conditions which make for better quality than on the general farm, and reach the consumer without going through cold storage, so that it is easy to account for the difference in the proportion of the retail price which the poultryman receives compared with the average farmer located several hundred miles from the great consuming centers.

Other large plants confined to breeding poultry have been developed primarily for the production of breeding stock or eggs, with culls sold to the market. Such breeding farms require a large investment, skillful management, and economical business methods to be successful. The labor problem is very difficult on such a farm, even more difficult than in most other lines of agricultural work. Large breeding farms representing considerable capital and the small farms combining market poultry and breeding stock, which are built gradually and grow into breeding farms, are among the successful poultry farms of the present day.

### IMPROVED METHODS OF MARKETING EGGS AND POULTRY.

The bulk of the poultry products is marketed through poultry packing houses devoted entirely to this business or connected with a creamery plant. (See Pl. XXXII.) These products ordinarily pass through many hands before they reach the consumer.

Generally they go from the farm to the country store, afterwards to the local egg or poultry buyer, then to the poultry packing house, and through cold storage to the jobber, and finally the retailer supplies them to the consumer. This condition necessarily makes the consumer pay a high price for the products, while the farmer receives only a comparatively small part of the retail price. When we consider that in many cases the goods are practically finished products when they leave the farm, there is, as before stated, very little incentive for the farmer to adopt better methods of production and marketing, as it is almost impossible to get so many different units to work for general improvement.

Better methods of producing and marketing poultry products will eliminate much of the present loss in eggs and poultry, and will enable the buyer to pay the farmer higher prices and offer him more encouragement in improving conditions, although much of the poultry products will for many years go through the present channels of marketing. Refrigeration and refrigerator cars have been and are a most important factor in preserving the quality of poultry and eggs. Cooperative marketing of eggs through creameries has proved satisfactory in several instances and has eliminated part of the expense of marketing, giving the producer a larger part of the consumer's cost. This plan, however, has only been worked out on a small scale as yet. Even a slight improvement in the present conditions of production and marketing along the ordinary channels of trade would cause a great saving throughout the country.

### INCREASE IN POULTRY LITERATURE, EXHIBITIONS, AND EDUCATIONAL METHODS.

Accompanying the great growth in poultry production, and aiding largely in its development, may be mentioned the enormous increase in poultry papers and poultry advertising. The poultry business supports over 100 poultry papers in the United States, some carrying 100 pages of poultry advertising matter, with a guaranteed monthly circulation of over 60,000 copies. The prices received for breeding stock and eggs and the success of the breeding farms are the great factors in this increased circulation and size of the poultry papers, as the managers of such farms find that extensive and novel advertising is one of the essentials to success.

Poultry shows also have increased in direct proportion with the growth in poultry breeding, the most popular varieties of fowls exhibited being Plymouth Rocks, Wyandottes, Rhode Island Reds, Orpingtons, and Leghorns. The last named is a strictly egg-laying variety; the others are general-purpose fowls which combine good egg-laying qualities with size and a propensity for fattening. Plate XXXIII illustrates typical specimens of general-purpose and egg-laying fowls. Large and successful poultry shows are held throughout

the entire country, while large exhibits of well-bred birds are found at most of the agricultural fairs. The number of poultry shows, as reported by one of the leading poultry papers, has practically doubled during the past ten years. All the shows are not included in this report, but it probably represents the relative growth in their size and number.

Lastly, attention is called to the rapid development in poultry education and experimentation within the past few years. The first poultry school was established in 1898 by the Rhode Island Agricultural College at Kingston, R. I. At present some instruction in poultry husbandry is given in nearly every State, while about one-third of the State colleges are holding special poultry schools. In addition, educational work in poultry husbandry is being developed by college or school instruction through extension work by most of the State colleges and experiment stations, by many of the State boards of agriculture, and by several railroad companies, working either individually or in cooperation. While the recent development in poultry husbandry has been quite rapid, this subject does not as yet get its fair share of attention compared with its relative importance in agricultural production, but present indications are that it is gradually taking its proper place in animal husbandry work.

## SUMMARY.

1. The growth in all branches of poultry work has been very marked during recent years. The annual value of the poultry products for 1910 is estimated at $750,000,000, which compares favorably with the estimated values of the cotton, hay, or wheat crops for the same year.

2. The Middle West is the source of greatest production, but recent growth in the Far West and in the South has been very marked.

3. With the growth in production, the average price of poultry products has increased considerably and there has been a marked improvement in the methods of producing and marketing, resulting in better quality and saving a part of the great loss due to carelessness in production and marketing. In this respect refrigeration has played a most important part.

4. Breeding poultry as a business has developed rapidly, putting this line of farming on a firm, sound basis. The breeding business has been built up not only by small breeders who have gradually developed breeding farms from small beginnings in raising poultry for the market, or the combination of market and fancy poultry, but also by capitalists, who have taken advantage of the high prices for poultry and eggs and have developed large poultry farms.

5. The poultry papers, poultry shows, and educational poultry work have all assisted in increased production and improvements, and prepared the way for further healthy growth.

# THE SLAUGHTER AND CONSUMPTION OF FOOD ANIMALS IN THE UNITED STATES FOR THE YEAR 1909.

By JOHN ROBERTS,
*Of the Editorial Office, Bureau of Animal Industry.*

The data gathered in connection with the latest decennial census (1910) make it possible for the first time to present complete statistics of a year's slaughter and consumption of food animals in the United States based on definite information. Previously our data on this point included only one class of slaughtering that was known with any degree of exactness, namely, the wholesale and packing. This has always been available from a number of commercial sources and more particularly in recent years from the Census Bureau, whose Division of Manufactures has ascertained its extent on three separate occasions at quinquennial periods—for the years 1899, 1904, and 1909. In a slightly less degree this same class of slaughtering has been known from year to year as the "Federally-inspected" slaughter, the details of which are published annually in the report of the Chief of the Bureau of Animal Industry, United States Department of Agriculture (see page 39 of this volume for the data for the fiscal year 1911).

It may be observed, however, from the table below that this wholesale slaughter represents less than two-thirds of the total slaughter of the country, the remainder consisting of the slaughter by small butchers and the slaughter on farms. Each of these two classes is quite considerable in extent, and hitherto they have had to be estimated in some other way than by actual determination. It is therefore most satisfactory that the last census has included them in its data.

In connection with the data referring to the consumption of pork, as well as to other details concerning hogs and their products, it is unfortunate that the year 1909 was an abnormal hog year. For reasons which need not be detailed here (they were briefly referred to in the Twenty-sixth Annual Report of this bureau, for 1909, page 301) there was a great scarcity of hogs in that year, the receipts at the principal markets aggregating about 5,000,000 less than in the preceding year. The consumption and trade in hogs and pork products in 1909 were probably, therefore, considerably below the normal.

The various totals and computations concerning the slaughter, consumption, etc., of each class of food animals, together with their equivalent in dressed meat, in 1909 are shown in the following statement:

*Statistics of the slaughter, consumption, and export of food animals in the United States, calendar year 1909.*

| Item. | Cattle. | Calves. | Swine. | Sheep. | Goats. | All animals. | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Total meat.[1] | Per cent of total slaughter. | Per cent of total output. |
| | *Number.* | *Number.* | *Number.* | *Number.* | *Number.* | *Cwts.* | | |
| 1. Total slaughter in United States (addition of items 2 and 3) | 13,682,875 | 6,500,562 | 52,002,936 | 14,565,714 | 279,042 | 167,294,473 | 100.00 | 99.21 |
| 2. Total commercial slaughter (Census) | 12,274,235 | 5,368,962 | 36,624,419 | 14,036,188 | 160,153 | 134,508,611 | 80.40 | 79.77 |
| 3. Farm slaughter (Census) | 1,408,640 | 1,131,600 | 15,378,517 | 529,526 | 118,989 | 32,785,903 | 19.60 | 19.44 |
| 4. Wholesale slaughter and packing (Census) | 8,114,860 | 2,504,728 | 33,870,616 | 12,255,501 | [2] 33,224 | 103,892,790 | 62.10 | 61.61 |
| 5. Federally-inspected slaughter (Bureau of Animal Industry) | 7,713,807 | 2,189,017 | 31,394,896 | 11,350,349 | [2] 100,659 | 97,227,493 | 58.12 | 57.66 |
| 6. Retail commercial slaughter (subtraction of item 4 from item 2) | 4,159,375 | 2,864,234 | 2,753,803 | 1,780,687 | 126,929 | 30,615,821 | 18.30 | 18.16 |
| 7. Exports: | | | | | | | | |
| Alive | 184,957 | ..... | 11,886 | 54,613 | ..... | 1,335,395 | ..... | ..... |
| As meat, etc. (calculated) | 284,261 | ..... | 6,322,070 | 37,575 | ..... | 11,294,931 | 6.75 | 7.49 |
| 8. Consumed in United States | 13,398,614 | 6,500,562 | 45,680,866 | 14,528,139 | 279,042 | 155,999,542 | 93.25 | 92.51 |
| 9. Total output (consumption and export) | 13,867,832 | 6,500,562 | 52,014,822 | 14,620,327 | 279,042 | 168,629,868 | ..... | 100.00 |
| 10. Total number alive Apr. 15, 1910 (Census) | 63,682,648 | | 59,473,636 | 52,838,748 | 3,029,795 | ..... | ..... | ..... |
| 11. Estimated number alive Jan. 1, 1909 | 65,480,375 | | 64,070,948 | 51,781,973 | ..... | ..... | ..... | ..... |
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Total per cent.* | | |
| 12. Per cent of Federally-inspected slaughter to total slaughter | 56.38 | 33.67 | 60.37 | 77.93 | 36.07 | 58.12 | ..... | ..... |
| 13. Per cent of total commercial slaughter to total slaughter | 89.71 | 82.60 | 70.43 | 96.36 | 57.39 | 80.40 | ..... | ..... |
| 14. Per cent of wholesale commercial slaughter to total slaughter | 59.31 | 38.53 | 65.13 | 84.14 | 11.91 | 62.10 | ..... | ..... |
| 15. Per cent of retail commercial slaughter to total slaughter | 30.40 | 44.07 | 5.30 | 12.22 | 45.48 | 18.30 | ..... | ..... |
| 16. Per cent of farm slaughter to total slaughter | 10.29 | 17.40 | 29.57 | 3.64 | 42.61 | 19.60 | ..... | ..... |
| 17. Per cent of Federally-inspected slaughter to total commercial slaughter | 62.85 | 40.83 | 85.72 | 80.86 | 62.85 | 72.28 | ..... | ..... |
| 18. Per cent of Federally-inspected slaughter to wholesale slaughter and packing | 95.06 | 87.40 | 92.69 | 92.61 | [2] 302.97 | 93.58 | ..... | ..... |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 19. Per cent of total slaughter to estimated stock on hand Jan. 1, 1909 | 30.82 | | 81.16 | 28.13 | | | | |
| 20. Per cent of total exports to total output | 3.38 | | 12.18 | 0.63 | | 7.49 | | |
| 21. Per cent of total output consumed in the United States | 96.62 | 100.00 | 87.82 | 99.37 | 100.00 | 92.51 | | |
| | *Pounds.* | *Pounds.* | *Pounds.* | *Pounds.* | *Pounds.* | *Pounds.* | | |
| 22. Per capita consumption in the United States (dressed meat) | [3] 80.34 | [4] 7.54 | [5] 67.61<br>[6] 10.06 | [7] 6.58 | [8] 0.13 | [9] 162.20<br>[6] 10.06 | | |

[1] This column shows the estimated weight of the dressed carcasses, including lard of swine.
[2] For explanation of discrepancy in goats see p. 258.
[3] Beef.
[4] Veal.
[5] Pork.
[6] Lard.
[7] Mutton.
[8] Goat.
[9] Total meat.

## THE SLAUGHTER DATA.

The census data concerning the slaughter of food animals in 1909 are embodied in three reports: (1) the wholesale slaughter and meat packing, (2) the entire commercial slaughter, and (3) the farm kill. The first is necessarily included in the second, and the second and third added together give the total slaughter in the United States, as is shown in item 1 of the table. Item 2, the total commercial slaughter, was reported by the Division of Manufactures of the Census Bureau, while item 3, the farm kill, was ascertained by the Division of Agriculture. The commercial slaughter was procured from 26,852 establishments, ranging from the small country butcher to the great packing concern. The number of farms upon which animals were slaughtered during 1909 has not been ascertained, except for each species separately, and the addition of all the species would, of course, result in duplication of farms. It may be stated, however, that swine alone were slaughtered on 3,643,646 farms.

There are three other classes of slaughter in the table, items 4, 5, and 6, all of them commercial classes and therefore included in item 2. Items 4 and 5 represent the wholesale trade and include all the firms in the meat trade operating in a large way, while item 6, which is merely the difference between items 2 and 4, shows the details of the slaughter by small butchers. Item 4, the wholesale and packing, as before stated, is compiled every five years by the Census Bureau; and item 5, the Federally inspected slaughter, is reported in full every year by the Bureau of Animal Industry, which has charge of the Government meat inspection. These two classes are to a great extent similar, but the inspected slaughter does not quite cover all the wholesale slaughter reported by the census for the reason that a comparatively few wholesale firms do business entirely within their own States and so are exempt from the Government inspection.

With the exception of item 4 (wholesale and packing) all the slaughter reports used in the table are given in terms of animals only, and as each species of animals varies in size and weight it is necessary, in order to show a total result, to combine them by reducing all to a meat basis. For this purpose factors have been used which have been computed from the census report above indicated. This report deals with enormous numbers of the various animals and gives, among other data, their total weights on the hoof and after being dressed. The averages yielded by these weights are as follows: For cattle, 1,019 pounds live, 543 dressed, per cent dressed 53; for calves, 167 live, 105 dressed, per cent 63; for swine, 202 live, 154 dressed, per cent 76; for sheep, 81 live, 41 dressed, per cent 50. These averages are, of course, too low for high-class butcher animals, but they would be too high for scrub stock, and they are, no doubt, approximately accurate for all the animals slaughtered in the country.

## DISTRIBUTION OF MEAT SLAUGHTERING.

By the use of the dressed weights above mentioned the total meat in the sixth column of the table is arrived at. From this it is seen the entire amount slaughtered in 1909 was 167,294,473 hundredweights. It is interesting to note the proportion of this total contributed by the various classes of slaughter. Thus, a fraction over 80 per cent was slaughtered commercially, and a fraction under 20 per cent on farms. The wholesale slaughter amounts to 62 per cent, so that the retail butchers account for a little over 18 per cent, which is slightly less (1¼ per cent) than the farm kill. Lastly, the Federally inspected slaughter is a trifle over 58 per cent, and is 4 per cent less than the wholesale and packing.

It may be observed that, as might be anticipated, the farmers slaughter a great many more hogs than any other farm animals, a total of 15,378,517 having been killed on farms during the year. This represents 72 per cent of the total meat slaughtered on the farm. The retail butchers, on the other hand, slaughtered a great preponderance of cattle and calves and relatively few sheep and swine.

Six and three-quarters per cent of the total meat slaughtered was exported, and the great majority of these exports were swine products, of which lard is the principal item. The swine products, in fact, constituted 86 per cent of the total exports. The live exports are considerably less than the meat products; they are, roughly, about one-fifth of the latter. The combined exports amounted to 7½ per cent of the total output.

Imports of meat products are so insignificant that they are not specifically mentioned in the returns; they are, therefore, disregarded in these estimates. The condemnations of animals and meat are also omitted, although they are quite considerable in the aggregate. They are, however, in a measure offset by a certain amount of unenumerated meat and meat products in the commerce returns which can not be classified. The meat condemned under the Federal inspection amounts to about one-half a pound per head of the population yearly.

## PERCENTAGE OF THE VARIOUS CLASSES OF SLAUGHTER.

A number of interesting comparisons are shown by means of percentages in items 12 to 21 of the table. The figures in the first five columns refer to the various classes of animals, and there is a total per cent in the last column based on the estimated meat value of the animals, as given in the upper part of the table.

First, it may be noted how the various classes of slaughter compare with each other when considered in connection with the total slaughter of the country. These comparisons are shown in items 12 to 16. It may be seen that the Federally inspected slaughter is

most frequent in sheep and least frequent in calves. Only one-third of the calves slaughtered come under the Government inspection, whereas over three-fourths of the sheep are Federally inspected. Slightly over 60 per cent of the swine and 56 per cent of the cattle slaughtered were inspected by the Government.

The percentages for wholesale slaughter and packing (item 14) follow closely those of the Federal inspection, although they are in every case higher, except for goats. This comparison is shown more definitely in item 18. The inspection data are, without doubt, the most accurate of any in the table, and the difference in the goat figures in this case shows that all of these animals were not accounted for in the census schedules. The total number is unimportant, however, and the discrepancy is probably due to the fact that in some instances the goats were either disregarded altogether or counted in with the sheep. It may be seen from the last column that the aggregate excess of the wholesale over the Federally-inspected slaughter was 4 per cent.

A remarkable feature of the slaughter by country butchers (retail commercial) is the very low percentage for swine, only a fraction over 5 per cent coming under this head. On the other hand, the percentages for goats, calves, and cattle are very high. The farm slaughter, as before stated, is exceedingly high in swine, and a relatively large number of goats are also disposed of on farms.

## PERCENTAGE OF YEARLY SLAUGHTER OF ANIMALS TO NUMBER ON HAND AT BEGINNING OF YEAR.

Some interesting comparisons are possible in connection with items 10, 11, and 19 of the table, which refer to the total number of animals alive at the beginning and end of a year, and the proportion slaughtered during the year. It will be observed that the period of commencing and ending the year is not quite concurrent in the two cases. This was unavoidable, because the census of animals was taken as of April 15, 1910, whereas the data concerning the output cover the calendar year 1909. However, with the possible exception of swine, the census figures are approximately correct for January 1 of the same year in each case, as the number of births up to April 15 would be about offset by the number sold. A correction of 5 per cent is made in the case of swine; that is, the number on hand January 1 is estimated to be 5 per cent less than the number on April 15.

The number of animals estimated to be on hand January 1, 1909, (item 11), is determined by the use of the percentages annually established by the Bureau of Statistics, Department of Agriculture, when estimating the number of farm animals in the country January 1 each year. According to these percentages there were at the close of 1909, as compared with the beginning, 100.4 per cent of dairy cows, 95.7 per cent of "other cattle," 102 per cent of sheep, and 88.2

per cent of swine. The application of these percentages, with the deduction of 5 per cent for swine, gives us the totals in item 11 of the table, which may fairly represent the numbers of the various animals at the commencement of the year covered by the slaughter operations.

Item 19 shows the percentages of the animals slaughtered during the year to be as follows: Cattle (including calves) 30.82, swine 81.16, and sheep and lambs 28.13. Similar percentages have been published for United Kingdom and Germany, and these are shown in comparison with those for the United States in the following table.

The British figures were computed by R. H. Rew in an article in the Journal of the Royal Statistical Society of England, 1904; those for Germany appeared in 1905 in the official quarterly statistical publication of the Government.

*Comparison of annual slaughter of food animals to number on hand at beginning of the year in United States, United Kingdom, and Germany.*

| Country. | Cattle. | Swine. | Sheep. |
|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* |
| United States, 1909 (year commencing January) | 30.8 | 81.2 | 28.1 |
| United Kingdom, average, 1899 to 1903 (year commencing June) | 26.6 | 121.3 | 37.9 |
| Germany, 1904 (year commencing December) | [1] 20.2 | 110.4 | 37.2 |

[1] Not including calves.

As would be anticipated, the British percentages average the highest because of their highly developed system of breeding for meat production, coupled with the stable condition of their markets. There is one exception, however, the United States percentage for cattle being higher than the British. This may be accounted for by the fact that there were proportionately fewer calves in the United States total, owing to the year commencing in January, as against June for the United Kingdom. The British total would, therefore, include more young animals, which would naturally operate to lower the percentage of output for the year. The German figure for cattle is low because the calves are not included, and for this reason it is not strictly comparable with the others.

It will be observed that the only considerable variation in the table consists in the abnormally low percentage of swine for the United States. This is attributed to the peculiar conditions, previously referred to, which existed in 1909 with regard to these animals. It may be remembered that our hog markets were quite demoralized during 1908, and values became so low that a great many farmers were evidently compelled either to suspend or curtail hog raising. Hence breeding operations in the spring of 1909 were greatly restricted, and the percentage in the table simply proves how extensive this

restriction really was. Thus, according to item 11, we had, in round numbers, 64,000,000 swine in the country at the beginning of the year, which number was reduced to 59,500,000 at the end of the year (see item 10), a difference of 4,500,000. Therefore the total number disposed of during the year—52,000,000 (see item 9)—is composed of this 4,500,000 plus the number raised for market during the year, or 47,500,000. Now, if we assume the same percentage as that of Germany, 110, which should be about the normal figure, the number which should have been available for the year's slaughter is 110 per cent of 64,000,000, or, in round figures, 70,000,000. If we assume, further, a stationary herd from year to year, it will be seen there should have been 70,000,000 raised in 1909 instead of 47,500,000. In other words, the swine breeding in 1909 was about 22,000,000, or 31 per cent, below normal.

## THE PER CAPITA CONSUMPTION OF MEAT.[1]

It will be readily understood from what has been said in the foregoing that, having as a basis the data established in item 8 of the table, it is possible to estimate the consumption of meat per head of the population with more accuracy than has been the case with former estimates. In order to arrive at the quantity of each kind of meat consumed per head during the year, it is merely a question of dividing the population into the respective totals of item 8, after converting the latter into meat by the process previously explained.

The population of continental United States on June 1, 1909, as given in a census report, was 90,556,521. This number when divided into the various meat totals gives the following results in dressed meat per head for the year:

*Per capita consumption of dressed meat in United States, 1909.*

| | Pounds. |
|---|---|
| Beef | 80.34 |
| Veal | 7.54 |
| Pork (excluding lard) | 67.61 |
| Mutton and lamb | 6.58 |
| Goat meat | .13 |
| Total meat | 162.20 |
| Lard | 10.06 |
| Total meat and lard | 172.26 |

Regarding the consumption of the various kinds of meat here shown it may be a little surprising to learn that more beef is consumed than pork, even with the lard included, and that more veal is eaten than

[1] Strictly speaking, meat is the flesh of vertebrate animals intended for food, and therefore would include poultry, game, rabbits, fish, etc.; but it is practically impossible to get accurate data on the amount consumed in these minor classes. Statistics of per capita consumption of meat are therefore usually confined to the flesh of the cattle, sheep, and swine species, or what is known as "butchers' meat."

mutton and lamb. Attention is again called, however, to the scarcity of swine in 1909. With a normal supply the difference between the beef and pork figures would not be so great.

It will be noted that the lard is given separately in the above statement. This being a wholly edible product, it is generally included in the dressed weight of swine, and for this reason it is the usual practice in per capita estimates to include it with pork. However, since it is not meat, it has in this case been separated from the other pork products, so that a total can be shown which is as nearly as possible all butchers' meat.

### THE CONSUMPTION OF LARD.

The following method was adopted in computing the lard consumption: Since the total number of hogs slaughtered is already established in item 1 of the table, it is necessary only to provide an average weight of lard per animal in order to arrive at the total production, and when the exports are deducted, the remainder will represent the amount consumed in the United States. While the proportion of lard in a hog varies according to the weight and type of the animal (Wilder, in "The Modern Packing House," cites a number of tests where the yield of lard in hog dressing varies from 10 to 14½ per cent of the live weight and states the general average to be close to 14 per cent), the average for the United States is no doubt very closely approximated in the Cincinnati Price Current's annual statement of the commercial hog packing of the country. This authority gives the average for 1909 as 13.75 per cent for the western slaughtering, and eastern slaughtering is stated to yield slightly less than western. Therefore 13.50 per cent is taken as fairly representative of the whole country.

By applying this average to the swine in the table, the average live weight of which is 202 pounds, we get 27.27 pounds of lard per animal, and the total amount produced in the year comes to 1,418,444,196 pounds, of which 506,680,491 pounds were exported. It may be mentioned that this export total includes, in addition to the lard proper, 10 per cent of the lard compounds exported and 25 per cent of the oleo exports, it being estimated that this proportion of lard is contained in these products. The amount left for home consumption is 911,763,705 pounds, or 10.06 pounds per head of the population.

### NONEDIBLE AND EXTRA-EDIBLE PARTS OF MEAT CARCASSES.

The ordinary butchers' or "dressed" meat has been the kind previously considered in this paper, since it represents the dead weight of an animal in general usage, and the figures which have been computed from this basis are therefore comparable with similar figures that have been established from time to time for other countries.

It should be understood, however, that this "dressed" weight includes the bones and other waste material, but does not include certain extra-edible parts, such as the pluck, tripe, brains, tongue, etc. (the so-called "fifth quarter" of the butchers), which are classed as offal, although used for food purposes. These features, among others, were specially investigated by the Bureau of Statistics of this department in connection with the meat consumption for the year 1900, and are reported in Bulletin 55 of that bureau. It will be of interest to refer briefly to the results here, and thereafter apply the percentages to the year 1909, as they would doubtless be substantially accurate for this purpose.

The bones and trimmings were found to average per carcass as follows: Cattle, 24 per cent of the dressed weight; calves, 30.5 per cent; sheep and lambs, 25.5 per cent; and swine, 15 per cent. The dressed weight in the latter case includes the lard. When these percentages are applied to the total weight of meat annually consumed it appears that fully 3,000,000,000 pounds, or 20 per cent of the dressed meat sold for consumption, is composed of nonedible material.

The extra-edible parts of the various animals were found to average as follows, excluding the edible tallow so as to confine our data, as before, to meat proper: Cattle, 41.87 pounds; calves, 9.47 pounds; sheep and lambs, 1.03 pounds; swine, 25.05 pounds. The edible tallow, it may be remarked, is practically all supplied by adult cattle, the averages per animal being: Cattle, 56.22 pounds; calves, 0.22 of a pound; sheep and lambs, 1.03 pounds. The lard of swine has already been estimated in the preceding chapter to be 27.27 pounds per animal.

It may be observed, in passing, how the above results emphasize the superior economy of the swine carcass. It is lowest in percentage of bones and waste, and highest in the proportion of extra-edible parts and edible fat. In the two latter cases, of course, the size of the animal must be taken into consideration when comparing swine with cattle.

### CLASSIFIED PER CAPITA CONSUMPTION OF MEAT IN THE UNITED STATES, 1909.

Having the above-mentioned data regarding the nonedible and the extra-edible parts of the carcasses, it is possible to present the table below, showing the meat consumption per head of the population in a variety of ways. The consumption in terms of dressed meat, as previously determined, is repeated, after which are given the bones and butchers' trimmings, followed by the extra-edible parts of each species. From these three determinations several combinations are made as follows: The dressed meat plus extra-

edible parts, the edible dressed meat, and the edible dressed plus extraedible meat. The latter of course shows the total net consumption of edible meat.

Thus far the edible fats have been excluded. There is next shown the consumption per head of edible tallow in the case of cattle, calves, sheep, and goats, and of lard in the case of swine. Finally there are two combinations which include the edible fats, namely, the total edible meat and edible fat; and the total dressed meat with extra-edible parts and edible fat.

*Classified per capita consumption of meat and edible fat in the United States, calendar year 1909.*

| Per capita consumption of— | Beef. | Veal. | Pork. | Mutton and lamb. | Goat. | Total. |
|---|---|---|---|---|---|---|
| Dressed meat (excluding edible tallow and lard) | *Pounds.* 80.34 | *Pounds.* 7.54 | *Pounds.* 67.61 | *Pounds.* 6.58 | *Pounds.* 0.13 | *Pounds.* 162.20 |
| Bones and trimmings | 19.28 | 2.30 | 11.65 | 1.68 | 0.03 | 34.94 |
| Extra-edible parts | 6.19 | 0.68 | 12.64 | 0.17 | 0.003 | 19.68 |
| Dressed meat plus extra-edible parts | 86.53 | 8.22 | 80.25 | 6.75 | 0.133 | 181.88 |
| Edible dressed meat | 61.06 | 5.24 | 55.96 | 4.90 | 0.10 | 127.26 |
| Edible dressed plus extra edible (total edible meat) | 67.25 | 5.92 | 68.60 | 5.07 | 0.103 | 146.94 |
| Edible fat | 6.25 | 0.02 | 10.06 | 0.17 | 0.003 | 16.50 |
| Total edible meat and edible fat | 73.50 | 5.94 | 78.66 | 5.24 | 0.106 | 163.45 |
| Total dressed meat with extra-edible parts and edible fat | 92.78 | 8.24 | 90.31 | 6.92 | 0.136 | 198.39 |

Regarding the first item in the table—the consumption of "dressed" meat—it should again be noted that it is customary to include the lard in the dressed weight of swine but not to include the edible tallow in the dressed weights of the other species. If the above total is compared with others previously published for this and other countries, the lard should be added. When lard is added the total is increased from 162 pounds to 172 pounds.

It will be observed there are four different determinations in the table relating to the consumption of meat without the fats. These include the ordinary dressed meat which, as just mentioned, totals 162 pounds for the year. The deduction for bones and butchers' trimmings amounts to 35 pounds per head, so that the edible portion of the dressed meat is reduced to 127 pounds. The extra-edible parts, that is, the edible portions of the animal not included in the dressed weight, amount to 20 pounds per head, which increases the total edible meat to 147 pounds per head. The dressed meat, including bones, etc., and with the extra-edible parts added, totals 182 pounds per head.

Turning now to the edible fats, it is seen the consumption of lard is 10 pounds and that of tallow 6½ pounds per head. It may here be explained that the total output of edible tallow has been computed

from the basis of the average yield per animal previously mentioned, these averages being multiplied by the respective totals of the animals in item 1 of the main table. The total production for the year thus obtained is 785,971,454 pounds. This tallow enters into consumption almost wholly in the form of mixtures, such as the eleo products, lard compounds and substitutes, etc. The exports of tallow and of products containing tallow are quite considerable, the chief item (about two-thirds of the total) being oleo oil. An approximation of the quantity exported in 1909 may be had by adding to the straight tallow exports 75 per cent of the oleo products and 20 per cent of the compounds exported. This gives a total export in round figures of 187,000,000 pounds for the year. There is left, therefore, 599,000,000 pounds for the home consumption, which is 6½ pounds per head of the population. Of this total, 96 per cent is supplied by adult cattle.

The last two per capita totals in the table include the lard and tallow. It is seen that the total edible product of the animals consumed comes to 163 pounds per head. The final determination is the largest of all. According to this the total consumption of meat as sold by the butcher, with the edible fat added, reached a fraction over 198 pounds per head of the population during 1909.

## COMPARISON OF PER CAPITA CONSUMPTION WITH THAT OF PRINCIPAL EUROPEAN COUNTRIES.

Detailed statistics of meat consumption in several of the principal European countries have been published from time to time, and so are available for comparison with the figures which have been established for the United States. Below is a table showing, in comparative form, the meat consumption per head of the population in the United States, the United Kingdom, Germany, and France. In addition to the actual quantity of each kind of meat consumed in each case, the proportional amount is also shown in the percentage columns.

*Per capita and proportional consumption of dressed meat in United States, United Kingdom, Germany, and France.*

| Kind of meat. | United States (1909). | | United Kingdom (average, 1906–1908). | | Germany, (1909).[1] | | France (1904). | |
|---|---|---|---|---|---|---|---|---|
| | *Pounds.* | *Per cent.* | *Pounds.* | *Per cent.* | *Pounds.* | *Per cent.* | *Pounds.* | *Per cent.* |
| Beef | 80 | 47 | 56 | 47 | 36 | 32 | 37 | 46 |
| Veal | 7½ | 4 | 4 | 3 | 7½ | 7 | 8 | 10 |
| Mutton and lamb | 6½ | 4 | 26 | 22 | 2½ | 2 | 9 | 11 |
| Pork (including lard) | 78 | 45 | 33 | 28 | 67 | 59 | 26 | 33 |
| Total | 172 | 100 | 119 | 100 | 113 | 100 | 80 | 100 |

[1] The farm slaughter in Germany is for 1907.

The figures for the United States and Germany are for the same year, 1909, except that the farm slaughter in the latter case is for 1907, this being the latest year when it was ascertained. The British figures represent the triennial average from 1906 to 1908. No data are available for France since 1904, when the above estimate was quoted in a paper by R. H. Rew read before the British Royal Statistical Society in that year.

A few remarks regarding the methods employed in securing the data for the several countries may be appropriate. The data for the United Kingdom are taken from a comprehensive paper by R. H. Hooker, of the British Board of Agriculture, which appeared in the Journal of the Royal Statistical Society of England for June, 1909. The English consumption naturally divides itself into two main divisions, now almost of equal size, namely, the home supply and the supply brought in from the colonies and from foreign countries. The latter is of course definitely known from the commerce reports, while the home supply is carefully calculated from the basis of the number of live breeding animals in the country, which are enumerated each year. It is interesting to note Mr. Hooker's figures showing the percentages of the home to the total supply for the year 1908. They are as follows: Beef, 60 per cent; mutton, 56 per cent; pork, 42 per cent; all meat, 54 per cent. Thus close upon one-half, or approximately 2,500,000,000 pounds, of the meat consumed in the United Kingdom is brought oversea.

The consumption for Germany is obtained by the same method as that for the United States in the present instance, that is, by direct slaughter data. All animals intended for food are slaughtered under Government inspection in Germany except those slaughtered on farms for the farmers' own use. It may here be remarked that the proportion of inspected and uninspected slaughter in 1909 was 82 and 18 per cent, respectively. It may be mentioned that a considerable number of horses are annually slaughtered for food in Germany as well as a few dogs, all under inspection. The horses thus slaughtered in 1909 numbered 152,214, and they provided about 79,000,000 pounds of meat, which is approximately 1¼ pounds per capita. This meat is not included in the table. The dogs slaughtered for food in 1909 numbered 6,990.

No recent statistics of meat consumption for France are available. It may be observed from the figures in the table that the French people are very moderate meat consumers, and this applies especially to the rural population, more so, probably, than is the case with the other countries under consideration. The production and consumption of meat in the city of Paris are published annually in the Statistique Agricole Annuelle, and this shows that in recent years the consumption per head in the capital is between 150 and 160 pounds

per annum. Regarding the consumption of horseflesh in France, it may be said that the industry is highly developed, as it is in Germany. The above-mentioned statistical annual, however, gives statistics for only that section of the country in which Paris is situated. It states that the number of horses slaughtered in the Department of the Seine in 1910 was 60,338, of which 1,837, or 3 per cent, were condemned. The meat produced from the 58,501 passed for food totaled, in round figures, 29,000,000 pounds, which makes an average of 493 pounds per animal. De Loverdo, in Les Abattoirs Publics, published in 1906, showed the consumption of horseflesh to be on the increase in French cities, and his figures indicated a total consumption of a fraction over 1 pound per head of the population of France.

Estimates of the per capita consumption of meat in other foreign countries have been made by various authorities, although none are of recent date. The more important of these are here quoted.

| | Pounds. |
|---|---|
| Argentina | 140 |
| Canada | 129 |
| Denmark | 76 |
| Norway and Sweden | 74 |
| Belgium | 70 |
| Austria-Hungary | 64 |
| Russia | 50 |
| Spain | 49 |

SMALL CONSUMPTION OF MUTTON IN THE UNITED STATES.

In view of the growing scarcity and high prices of cattle and swine and their products in our markets in recent times, it is well to call attention to the comparatively insignificant part played by the ovine species in our meat dietary. It may be seen from previous statements that we consume only 6½ pounds of mutton and lamb per head of the population in a year, which is barely 4 per cent of the total meat consumption. In other words, for every pound of mutton and lamb eaten we eat 25 pounds of other meat. When we compare this small consumption of mutton with that of England a very striking contrast is presented. The table on page 264 shows that the British consume 26 pounds per head of mutton, or 22 per cent of their total meat. Relatively speaking this is rather more than five times the consumption of the United States. Our small consumption no doubt is mainly attributable to the exceedingly cheap and abundant supplies of beef and pork which have prevailed in former years, thus rendering it unnecessary to look elsewhere for meat. But the day of cheap meat is past, and the present market prices of food animals point to the fact that it is becoming more and more imperative that every available source

of our meat supply should be carefully developed. Hence the necessity for more sheep farming.

It is undeniable that the sheep species, both in the lamb stage and when older, furnishes meat of most excellent quality when the animals are suited for this purpose. Therefore the present seems to be an opportune time for stockmen to pay more attention to the raising of sheep for meat production. This bureau has for a long time recognized the country's lack in this respect, and has taken steps to improve the situation. Through its Animal Husbandry Division sheep-breeding experiments have been in progress for years, the most important of these being the cooperative work with the Wyoming Experiment Station for the purpose of producing a range type of sheep that will be of good mutton form as well as yield a heavy fleece. These, as well as other experiments with strictly mutton breeds, are still progressing satisfactorily.

Finally, it would be in the interest of economy for the people generally to cultivate a greater taste for mutton and lamb, especially the smaller families who require joints of a size that can not usually be supplied from the larger beef animals. A more insistent demand on the part of the public for mutton and lamb of good quality would no doubt soon lead to an increase of breeding and feeding operations, besides relieving somewhat the present heavy demand for beef and pork in the face of a short supply.

# MISCELLANEOUS INFORMATION CONCERNING THE LIVE-STOCK INDUSTRY.

Compiled by JOHN ROBERTS,
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## THE LIVE-STOCK MARKET IN 1911.

All classes of food animals at the great stock centers were cheaper in 1911 than they were the previous year. The table of average prices at Chicago, given on the next page, shows the greatest fluctuations to have occurred in hogs and sheep, while the cattle classes remained firm, at a near approach to the high level of 1910.

It was to be expected that hog values would come down considerably during 1911, as the high prices of 1910 had reached a prohibitive stage. These extraordinary prices, it may be remembered, were due to a serious deficit in the supply extending through 1909 and 1910. The disturbance in the hog market started with the glut and accompanying low prices of 1908, the average for that year having been $5.70 a hundredweight, the lowest for several years. In that year also the price of corn and other stock feeds rose sharply, which made a combination that caused the raising of hogs to be a losing proposition. Consequently farmers turned their attention to other lines which promised better profits, with the result that in 1909 hogs were scarce and values again high. The prices became, in fact, so tempting that every animal at all suitable was marketed, which brought about a greater scarcity than ever in 1910, and the prices in the early spring of that year were the highest on record.

Naturally this condition of affairs stimulated hog raising throughout the country, and so something like a normal supply was forthcoming in 1911. Prices dropped correspondingly, the average having been $2.20 a hundredweight, or 25 per cent, less than in 1910. However, the hog quotations throughout the year were still a shade higher on the whole than those for cattle.

The situation as regards sheep was an unfortunate one at the close of 1911. During the latter half of the year the market was oversupplied, prices could not be maintained, and consequently many producers lost money. The average price for all grades of sheep for 1911 fell to $3.95, a decline of $1.30 from 1910, and was the lowest since 1901. Lambs followed suit with an average of $5.95, as against $7.55 in 1910.

The tables show the monthly and annual average and range of prices of the various classes of farm stock at Chicago for a series of

years. In the case of the tables which give the range, it should be borne in mind that the mean between the high and low range does not necessarily give the true average.

*Average prices, per hundredweight, of live stock at Chicago in 1911, by months, and annual average, 1900–1911.*

[From the Chicago Daily Farmers and Drovers Journal.]

| Month and year. | Cattle. | | | Hogs. | Sheep. | Lambs. |
|---|---|---|---|---|---|---|
| | Native steers. | Fat cows and heifers. | Range steers. | | | |
| January | $6.15 | $4.35 | ..... | $7.95 | $4.10 | $6.20 |
| February | 6.15 | 4.45 | ..... | 7.40 | 4.15 | 6.05 |
| March | 6.20 | 4.60 | ..... | 6.85 | 4.70 | 6.10 |
| April | 6.10 | 4.55 | ..... | 6.25 | 4.20 | 5.50 |
| May | 5.95 | 4.60 | ..... | 6.00 | 4.45 | 5.85 |
| June | 6.05 | 4.25 | ..... | 6.25 | 3.80 | 6.10 |
| July | 6.30 | 4.40 | $5.65 | 6.70 | 3.95 | 6.30 |
| August | 6.95 | 4.60 | 5.00 | 7.30 | 3.50 | 6.35 |
| September | 6.80 | 4.45 | 5.50 | 6.90 | 3.80 | 5.70 |
| October | 6.75 | 4.35 | 5.70 | 6.45 | 3.65 | 5.75 |
| November | 6.70 | 4.05 | 5.85 | 6.30 | 3.45 | 5.45 |
| December | 6.75 | 4.00 | 5.75 | 6.10 | 3.55 | 5.75 |
| Annual average: | | | | | | |
| 1911 | 6.40 | 4.30 | 5.65 | 6.70 | 3.95 | 5.95 |
| 1910 | 6.80 | 4.60 | 5.40 | 8.90 | 5.25 | 7.55 |
| 1909 | 6.35 | 4.25 | 5.25 | 7.35 | 5.00 | 7.40 |
| 1908 | 6.10 | 4.10 | 4.80 | 5.70 | 4.65 | 6.35 |
| 1907 | 5.80 | 3.85 | 4.50 | 6.15 | 5.25 | 7.05 |
| 1906 | 5.30 | 3.70 | 4.40 | 6.25 | 5.20 | 6.85 |
| 1905 | 5.05 | 3.65 | 3.80 | 5.25 | 5.00 | 6.80 |
| 1904 | 4.95 | 3.55 | 3.65 | 5.15 | 4.25 | 5.60 |
| 1903 | 4.80 | 3.95 | 3.65 | 6.00 | 4.00 | 5.45 |
| 1902 | 6.20 | 4.70 | 4.95 | 6.80 | 4.20 | 5.50 |
| 1901 | 5.25 | 4.05 | 4.55 | 5.85 | 3.80 | 4.80 |
| 1900 | 5.15 | 4.05 | 4.35 | 5.05 | 4.55 | 5.90 |

*Range of prices, per hundredweight, of cattle at Chicago in 1911, by months, and annual range, 1900–1911.*

[From annual report of Union Stock Yard & Transit Co.]

| Month. | Native steers (1,500–1,800 pounds). | Native steers (1,200–1,500 pounds). | Poor to best cows and heifers. | Native stockers and feeders. | Texas and western steers. |
|---|---|---|---|---|---|
| January | $6.00–$7.00 | $5.05–$7.10 | $3.30–$6.25 | $3.25–$6.00 | ..... |
| February | 5.95– 6.90 | 5.30– 7.05 | 3.40– 6.30 | 3.50– 5.90 | ..... |
| March | 5.75– 6.90 | 5.05– 7.05 | 3.40– 7.00 | 3.75– 6.00 | $3.95–$5.80 |
| April | 5.75– 6.90 | 5.15– 6.85 | 3.25– 6.25 | 3.45– 5.80 | ..... |
| May | 5.75– 6.45 | 5.25– 6.50 | 3.35– 6.35 | 3.50– 5.75 | ..... |
| June | 5.90– 6.70 | 5.00– 6.75 | 3.10– 6.25 | 2.65– 5.85 | 4.00– 6.15 |
| July | 5.80– 7.35 | 5.10– 7.15 | 3.15– 6.80 | 2.50– 5.50 | 4.00– 6.25 |
| August | 6.35– 8.20 | 5.35– 8.15 | 3.25– 7.00 | 2.50– 6.00 | 4.15– 7.25 |
| September | 7.25– 8.25 | 5.35– 8.20 | 3.25– 7.50 | 3.00– 5.85 | 4.15– 7.15 |
| October | 7.00– 9.00 | 4.85– 8.90 | 3.10– 7.00 | 2.85– 6.00 | 4.25– 7.40 |
| November | 7.35– 9.25 | 5.35– 9.00 | 3.00– 7.00 | 2.75– 6.00 | 4.50– 7.90 |

*Range of prices, per hundredweight, of cattle at Chicago in 1911, etc.*—Continued.

| Month. | Native steers (1,500–1,800 pounds). | Native steers (1,200–1,500 pounds). | Poor to best cows and heifers. | Native stockers and feeders. | Texas and western steers. |
|---|---|---|---|---|---|
| December | $7.00–$9.35 | $5.40–$9.25 | $3.00–$6.75 | $3.00–$6.00 | $4.60–$7.00 |
| Annual range: | | | | | |
| 1911 | 5.75– 9.35 | 4.85– 9.25 | 3.00– 7.50 | 2.50– 6.00 | 3.95– 7.90 |
| 1910 | 5.65– 8.75 | 4.85– 8.85 | 3.00– 8.00 | 2.90– 7.00 | 3.90– 7.75 |
| 1909 | 6.20– 9.50 | 4.90– 9.25 | 2.90– 7.50 | 2.50– 5.85 | 3.60– 7.60 |
| 1908 | 5.25– 8.40 | 4.00– 8.40 | 2.55– 7.50 | 2.00– 6.05 | 3.40– 7.50 |
| 1907 | 5.30– 8.00 | 3.95– 7.50 | 2.35– 6.25 | 2.00– 5.35 | 3.00– 6.75 |
| 1906 | 4.75– 7.45 | 3.90– 7.90 | 2.40– 6.60 | 1.75– 5.10 | 2.90– 6.35 |
| 1905 | 4.40– 6.80 | 3.00– 6.85 | 2.25– 6.80 | 1.50– 5.45 | 2.60– 5.25 |
| 1904 | 4.40– 7.65 | 3.35– 7.60 | 2.00– 7.50 | 1.50– 5.50 | 2.40– 5.65 |
| 1903 | 4.10– 6.75 | 3.35– 6.85 | 2.50– 5.50 | 1.50– 5.20 | 2.55– 5.10 |
| 1902 | 4.25– 9.00 | 3.60– 9.00 | 3.35– 8.25 | 1.90– 6.00 | 2.55– 7.65 |
| 1901 | 4.80– 9.00 | 3.60– 8.00 | 2.00– 8.00 | 1.65– 5.15 | 2.75– 5.75 |
| 1900 | 4.70– 7.50 | 3.90– 7.50 | 1.75– 6.00 | 2.10– 5.25 | 3.00– 5.90 |

Fifty-eight carloads of fat "show" cattle sold in the auction Thursday, December 7, 1911, at $7.90 to $15.75. The show sale averaged $11.05, as against $7.77 in 1910. The highest show average was $11.44, in 1909, for 52 carloads.

*Range of prices, per hundredweight, of hogs at Chicago, in 1911, by months, and annual range, 1900–1911.*

[From annual report of Union Stock Yard & Transit Co.]

| Month. | Heavy packing (250–500 pounds). | Mixed packing (200–250 pounds). | Light bacon (150–200 pounds). |
|---|---|---|---|
| January | $7.30–$8.25 | $7.50–$8.30 | $7.60–$8.25 |
| February | 6.60– 7.75 | 6.70– 7.85 | 6.90– 7.90 |
| March | 6.10– 7.20 | 6.25– 7.30 | 6.50– 7.35 |
| April | 5.65– 6.65 | 5.80– 6.85 | 5.80– 6.90 |
| May | 5.35– 6.27½ | 5.55– 6.37½ | 5.60– 6.50 |
| June | 5.55– 6.70 | 5.65– 6.72½ | 5.75– 6.70 |
| July | 6.10– 7.35 | 6.20– 7.40 | 6.25– 7.50 |
| August | 6.45– 7.80 | 6.60– 7.95 | 6.80– 7.95 |
| September | 5.75– 7.65 | 6.00– 7.80 | 6.15– 7.80 |
| October | 5.75– 6.85 | 5.70– 6.90 | 5.65– 6.85 |
| November | 5.70– 6.72½ | 5.65– 6.70 | 5.30– 6.65 |
| December | 5.85– 6.60 | 5.70– 6.65 | 5.40– 6.40 |
| Annual range: | | | |
| 1911 | 5.35– 8.25 | 5.55– 8.30 | 5.30– 8.25 |
| 1910 | 6.55–11.20 | 6.60–11.15 | 6.50–11.05 |
| 1909 | 5.60– 8.75 | 5.50– 8.70 | 5.20– 8.60 |
| 1908 | 4.00– 7.50 | 4.00– 7.50 | 3.95– 7.40 |
| 1907 | 3.75– 7.25 | 3.70– 7.22½ | 3.70– 7.17½ |
| 1906 | 5.00– 7.00 | 4.95– 7.10 | 4.90– 7.00 |
| 1905 | 4.35– 6.40 | 4.25– 6.42½ | 4.10– 6.45 |
| 1904 | 4.10– 6.30 | 4.15– 6.37½ | 4.00– 6.30 |
| 1903 | 3.85– 7.87½ | 3.90– 7.80 | 3.90– 7.70 |
| 1902 | 5.70– 8.25 | 5.65– 8.20 | 5.40– 7.95 |
| 1901 | 4.80– 7.37½ | 4.85– 7.30 | 4.75– 7.20 |
| 1900 | 4.15– 5.85 | 4.15– 5.82½ | 4.10– 5.75 |

Average weight of hogs at Chicago in 1911, 232 pounds. This is 5 pounds less than the average for 1910, but 13 pounds higher than the average for 1909. Eleven carloads of "show" hogs sold in the auction on Thursday, December 7, 1911, at $6.25 to $6.50, the average being $6.42, as against $7.57 in 1910 and $8.60 in 1909.

*Range of prices, per hundredweight, of sheep and lambs at Chicago in 1911, by months, and annual range, 1900–1911.*

[From annual report of Union Stock Yard & Transit Co.]

| Month. | Native sheep (60–140 pounds). | Native yearlings and lambs. | Western sheep (70–140 pounds). | Western and Mexican lambs. |
|---|---|---|---|---|
| January | $2.50–$4.50 | $4.50–$6.65 | $2.50–$4.75 | $4.75–$6.65 |
| February | 2.50– 4.85 | 4.50– 6.35 | 2.75– 4.85 | 4.50– 6.50 |
| March | 3.25– 5.35 | 4.25– 6.40 | 3.50– 5.60 | 4.50– 6.65 |
| April | 3.00– 5.00 | 4.00– 6.25 | 3.25– 5.25 | 4.00– 6.60 |
| May | 2.75– 5.25 | 4.25– 7.00 | 2.75– 5.60 | 4.25– 7.85 |
| June | 2.00– 4.50 | 3.75– 6.75 | 2.00– 4.70 | 3.90– 7.40 |
| July | 2.00– 4.75 | 2.50– 7.50 | 2.50– 5.25 | 5.75– 7.55 |
| August | 2.00– 4.00 | 3.00– 7.40 | 2.50– 4.00 | 5.25– 7.25 |
| September | 2.25– 4.40 | 3.75– 6.35 | 2.50– 4.50 | 4.25– 6.40 |
| October | 1.75– 4.25 | 3.75– 6.35 | 1.65– 4.25 | 4.00– 6.40 |
| November | 1.50– 4.00 | 3.50– 6.50 | 1.75– 4.25 | 4.00– 6.25 |
| December | 1.75– 4.40 | 3.40– 6.40 | 2.00– 4.60 | 4.00– 6.00 |
| Annual range: | | | | |
| 1911 | 1.75– 5.25 | 2.50– 7.50 | 1.65– 5.60 | 3.90– 7.85 |
| 1910 | 2.00– 9.00 | 4.00–10.25 | 2.90– 9.30 | 4.75–10.00 |
| 1909 | 2.25– 6.90 | 4.50– 8.80 | 2.75– 6.85 | 5.00– 9.00 |
| 1908 | 2.00– 7.00 | 3.25– 7.85 | 2.00– 7.00 | 3.75– 8.25 |
| 1907 | 2.00– 7.00 | 4.00– 8.60 | 2.00– 7.25 | 4.00– 9.25 |
| 1906 | 3.00– 6.50 | 5.00– 8.50 | 3.00– 7.00 | 4.75–11.25 |
| 1905 | 2.75– 6.35 | 4.00– 8.25 | 3.15– 6.35 | 4.50– 8.20 |
| 1904 | 1.50– 6.00 | 2.50– 7.75 | 2.00– 5.80 | 3.00– 7.50 |
| 1903 | 1.25– 7.00 | 2.50– 8.00 | 2.00– 7.00 | 2.50– 7.90 |
| 1902 | 1.25– 6.50 | 2.00– 7.25 | 1.25– 6.30 | 2.50– 7.60 |
| 1901 | 1.40– 5.25 | 2.00– 6.25 | 1.50– 5.25 | 2.75– 5.90 |
| 1900 | 2.00– 6.50 | 3.00– 7.60 | 3.00– 6.50 | 4.00– 7.60 |

Sixteen carloads of "show" sheep and lambs sold in the auction on Thursday, December 7, 1911, at $5.10 to $8.10, the average being $6.85, against $6.59 in 1910 and $8.67 in 1909. Seven loads of lambs sold at $7 to $8.75, averaging $7.50. Five lots of yearlings sold at $5.85 to $7.50, with an average of $6.72.

*Average prices of horses at Chicago in 1911, by months, and annual average 1904–1911.*

[From annual report of Union Stock Yard & Transit Co.]

| Month. | Draft horses. | Carriage pairs. | Drivers. | General use. | Bussers and trammers. | Saddlers. | Southern chunks. |
|---|---|---|---|---|---|---|---|
| January | $200 | $460 | $175 | $150 | $160 | ..... | ..... |
| February | 210 | 510 | 180 | 155 | 170 | ..... | ..... |
| March | 215 | 530 | 185 | 160 | 175 | ..... | ..... |
| April | 215 | 530 | 185 | 160 | 175 | ..... | ..... |
| May | 210 | 520 | 180 | 155 | 170 | ..... | ..... |
| June | 205 | 510 | 175 | 150 | 165 | ..... | ..... |
| July | 205 | 500 | 175 | 150 | 165 | ..... | ..... |
| August | 205 | 475 | 175 | 150 | 165 | ..... | ..... |
| September | 205 | 460 | 175 | 150 | 165 | ..... | ..... |
| October | 200 | 450 | 175 | 150 | 165 | ..... | ..... |
| November | 200 | 440 | 175 | 140 | 165 | ..... | ..... |
| December | 200 | 430 | 175 | 140 | 165 | ..... | ..... |
| Annual average: | | | | | | | |
| 1911 | 205 | 483 | 182 | 155 | 170 | $190 | $92 |
| 1910 | 200 | 473 | 172 | 144 | 161 | 177 | 87 |
| 1909 | 194 | 482 | 165 | 137 | 152 | 172 | 77 |
| 1908 | 180 | 450 | 156 | 129 | 138 | 164 | 69 |
| 1907 | 194 | 482 | 165 | 137 | 152 | 172 | 77 |
| 1906 | 188 | 486 | 158 | 154 | 147 | 174 | 72 |
| 1905 | 186 | 486 | 156 | 132 | 145 | 172 | 70 |
| 1904 | 177 | 475 | 150 | 140 | 140 | 160 | 64 |

## WHOLESALE PRICES OF MEAT IN HOME AND FOREIGN MARKETS.

The tables which follow show a comparison of the prices of fresh meats in this country and in the principal European cities during the past three years. The markets selected are Chicago, New York, London, Paris, and Berlin. In order that the comparison of the various kinds of meat may be as nearly accurate as the circumstances permit, a representative high grade is taken of each class in every case, so that the beef, veal, etc., quoted at one city will be similar in grade to that quoted at each of the others. The highest market class for carcass meat is used in most cases, but not in all, as in several instances this class partakes of a more or less fancy character, and so would not be fairly comparable with the others. Thus, the "Scotch" beef, mutton, and lamb on the London market, the "prime, city dressed" veal of New York, the "Doppellender" calves of Berlin, and the "extra" veal and pork of Paris are excluded.

The quotations are taken from well-known trade papers of the various countries represented, and are those published on the first Saturday of each month. The data for the European markets have been converted at the standard rates into the equivalents in United States weights and money.

In view of the great and increasing importance of Argentine beef in the world's markets, the prices of the best grade of this meat on the London market are given in the beef table below.

BEEF.

On comparing the beef prices at Chicago and New York during 1911 with those of the preceding year it is seen there is not much difference. The most noticeable variation occurred in the December quotations, which in 1911 were the highest for any period during the two years. London beef on the other hand was decidedly cheaper in 1911. Owing principally to heavy supplies from Argentina, all classes of beef depreciated to some extent compared with the previous year. During the greater part of 1911 English native beef was less than 1 cent a pound higher than Chicago, and in November and December the quotations were actually higher in Chicago and New York than they were in London. It is not surprising therefore that our former large export trade is being rapidly diverted into home channels.

The plentifulness and corresponding cheapness of Argentine beef may be seen by studying the figures in the table, particularly those of the last four months. In comparing these prices it should be noted that the Argentine, as well as the Parisian, quotations are for hind quarters, while the others are for whole sides. Hind quarters are valued at about 1½ cents a pound more than whole sides. After making this allowance we see that the prices for Chicago, New York, and English beef during the above-mentioned period ranged from 10¼ to 13 cents a pound, and the Argentine (chilled, not frozen) from 5 to 8½ cents. The latter in some instances was less than one-half the price of the others.

It must be remembered, however, that the quality is not the same. Argentine beef is grass fed, while the others are grain fed. Nevertheless much of the South American product is very good beef, and it is remarkable that it can be sold on the London market at the above prices. Frozen beef, it may be mentioned, sells for still less.

The United States port-killed beef, which is slaughtered at the ports of landing—London and Liverpool—was formerly an important market class, and was included in the table, but it is now discontinued. Our exports of live cattle in recent years are insignificant compared with those of a decade ago, and, in any event, the present price of port-killed beef is practically identical with that of the English beef quoted in the table.

*Wholesale prices, per pound, of fresh carcass beef at stated home and foreign markets, 1909 to 1911, at monthly periods.*

| Date. | Chicago. | New York. | London. | | Berlin. | Paris. |
|---|---|---|---|---|---|---|
| | Good native steers, carcass. | Choice native steers, heavy carcass. | English beef. | River Plate chilled (hind quarters). | Fat oxen. | Hind quarters. |
| | *Cents.* | *Cents.* | *Cents.* | *Cents.* | *Cents.* | *Cents.* |
| January.....1911.. | 10.0 -11.5 | 10.0 -10.5 | 10.6-11.7 | 8.1- 9.1 | 16.6-17.7 | 10.5-16.4 |
| 1910.. | 10.5 -12.0 | 10.5 -11.0 | 11.7-12.7 | 8.1- 9.1 | 16.2-17.3 | 7.0-14.6 |
| 1909.. | 10.5 -11.5 | 10.75 | 12.2-12.7 | 8.6-10.4 | 16.0-16.6 | 9.6-15.8 |
| February.....1911.. | 10.5 -11.25 | 10.0 -10.5 | 11.1-12.0 | 7.3- 8.6 | 16.4-17.5 | 9.7-14.9 |
| 1910.. | 10.0 -11.5 | 10.0 -10.5 | 11.7-12.2 | 8.6- 9.6 | 15.5-16.4 | 7.0-13.2 |
| 1909.. | 10.5 -11.5 | 10.0 | 10.6-10.9 | 7.6- 9.1 | 15.3-16.0 | 9.6-14.0 |
| March.....1911.. | 10.25-11.5 | 9.75-10.25 | 10.9-12.0 | 8.1- 9.1 | 16.0-17.1 | 10.5-16.4 |
| 1910.. | 10.0 -11.5 | 11.0 -11.5 | 11.7-12.2 | 7.6- 9.1 | 15.5-16.4 | 8.8-14.0 |
| 1909.. | 10.0 -10.5 | 10.0 | 11.4-12.2 | 8.1- 9.1 | 14.9-15.8 | 8.8-14.6 |
| April.....1911.. | 10.5 -11.0 | 9.75-10.25 | 11.4-12.2 | 8.1- 9.6 | 16.8-18.1 | 10.5-15.5 |
| 1910.. | 12.0 -12.5 | 12.0 -12.5 | 11.9-12.7 | 8.1- 9.6 | 16.2-17.3 | 8.8-14.0 |
| 1909.. | 10.0 -11.0 | 10.25 | 11.4-12.4 | 7.6- 9.1 | 15.1-15.8 | 8.8-15.4 |
| May.....1911.. | 10.5 -11.0 | 9.5 -10.0 | 11.7-12.4 | 10.1-11.1 | 16.8-17.9 | 10.5-15.8 |
| 1910.. | 12.0 -12.5 | 12.0 | 12.2-13.0 | 10.1-11.1 | 16.4-17.7 | 9.6-15.4 |
| 1909.. | 10.5 -11.0 | 10.0 | 11.6-12.2 | 10.4-11.1 | 14.9-16.0 | 10.5-16.7 |
| June.....1911.. | 10.0 -11.0 | 9.25- 9.5 | 10.9-11.7 | 6.8- 8.1 | 17.9-19.0 | 12.3-18.2 |
| 1910.. | 11.0 -12.0 | 11.75 | 12.7-14.0 | 11.1-12.7 | 17.1-17.7 | 9.6-15.4 |
| 1909.. | 11.0 | 10.0 -10.5 | 11.6-12.4 | 9.6-10.6 | 14.7-16.2 | 10.5-16.7 |
| July.....1911.. | 10.0 -11.0 | 9.25- 9.5 | 10.9-12.0 | 7.6- 8.6 | 17.9-18.6 | 11.4-16.4 |
| 1910.. | 11.5 -12.0 | 12.0 -12.5 | 12.4-13.2 | 9.1-10.1 | 17.7-18.1 | 8.8-16.3 |
| 1909.. | 10.5 | 9.75-10.5 | 12.9-13.7 | 10.6-11.7 | 15.1-16.4 | 8.8-15.8 |
| August.....1911.. | 10.5 -11.5 | 10.0 -10.5 | 11.7-12.2 | 9.1-10.6 | 17.5-18.6 | 11.4-18.2 |
| 1910.. | 11.0 -12.0 | 11.5 -12.0 | 12.7-13.7 | 10.1-11.1 | 17.9-18.6 | 9.6-16.3 |
| 1909.. | 10.5 | 9.75-10.5 | 11.4-11.9 | 8.1- 9.6 | 15.8-16.8 | 7.0-14.9 |
| September.....1911.. | 11.0 -12.5 | 11.5 -12.0 | 11.7-12.7 | 6.6- 8.1 | 17.1-18.1 | 8.8-14.0 |
| 1910.. | 11.5 -12.0 | 11.5 -12.0 | 12.2-13.2 | 7.6- 9.6 | 18.1-19.0 | 10.5-14.9 |
| 1909.. | 11.0 | 9.75-11.0 | 11.6-12.7 | 8.6-10.6 | 16.2-17.3 | 8.8-14.9 |
| October.....1911.. | 11.5 -12.0 | 10.25-11.5 | 10.6-12.2 | 8.1-10.1 | 16.8-18.6 | 10.5-14.6 |
| 1910.. | 11.5 -12.0 | 12.0 | 10.7-11.4 | 9.6-11.1 | 17.7-18.6 | 8.8-14.0 |
| 1909.. | 11.5 -12.0 | 11.0 -11.5 | 11.1-11.6 | 7.0- 8.6 | 16.0-17.0 | 7.0-14.9 |
| November.....1911.. | 11.5 -12.5 | 11.5 -12.5 | 10.1-12.2 | 6.6- 8.6 | 17.5-19.2 | 9.7-15.8 |
| 1910.. | 11.25-11.75 | 11.0 -11.5 | 11.0-12.4 | 6.0- 7.6 | 17.9-18.8 | 10.5-14.6 |
| 1909.. | 11.5 -12.0 | 11.0 -12.0 | 10.6-11.9 | 8.1-10.1 | 16.4-17.7 | 7.0-13.7 |
| December.....1911.. | 12.0 -13.0 | 11.5 -12.5 | 11.1-12.4 | 8.6- 9.6 | 17.5-19.2 | 9.7-14.0 |
| 1910.. | 11.25-11.75 | 10.0 -10.5 | 10.7-11.7 | 6.6- 7.6 | 16.6-17.5 | 8.8-13.7 |
| 1909.. | 11.0 -12.0 | 11.0 -11.5 | 10.9-12.7 | 8.1-10.1 | 16.2-17.5 | 7.9-13.2 |

## VEAL.

Three of the five cities in the table, namely, New York, Berlin, and Paris, have each a higher market class of veal than the one quoted. In New York the "prime city dressed" veals sell about 1 cent a pound above the "good to choice." Similarly, the "Doppellender," or "choice, whole-milk fed" calves of Berlin and the "extra" veal of Paris are excluded in order that the average grade of the meat in all the cities may be as nearly alike as possible.

It will be noted that Chicago veal was generally from 1 to 2 cents a pound cheaper than New York excepting in the spring and early summer, when the prices were identical. Good veal is an expensive article in the German capital; it averaged about 22 cents a pound for the whole year, which must have been prohibitive to the great majority of consumers. Parisian veal is high also, although from 3 to 6 cents cheaper than Berlin.

*Wholesale prices, per pound, of fresh carcass veal at stated home and foreign markets 1909 to 1911, at monthly periods.*

| Date. | Chicago. | New York. | London. | Berlin. | Paris. |
|---|---|---|---|---|---|
| | Good carcass. | Good to choice. | Best veal. | Choice fat calves. | First quality. |
| | *Cents.* | *Cents.* | *Cents.* | *Cents.* | *Cents.* |
| January....1911.. | 13.5-14.0 | 15.5-16.0 | 15.2-16.2 | 21.6-23.3 | 16.7-17.6 |
| 1910.. | 13.0 | 12.0-15.5 | 15.7-17.2 | 28.3 | 17.5-19.3 |
| 1909.. | 12.0 | 15.0-16.0 | 12.7-14.2 | 20.7-22.0 | 19.8-21.0 |
| February....1911.. | 13.5 | 15.0 | 15.2-16.2 | 21.6-23.1 | 18.2-19.3 |
| 1910.. | 13.5 | 13.5-16.5 | 14.2-16.2 | 27.7 | 18.1-19.3 |
| 1909.. | 11.0 | 14.0-15.0 | 13.7-15.2 | 19.2-20.5 | 18.1-19.3 |
| March....1911.. | 15.5 | 16.0 | 16.2-18.2 | 21.0-22.3 | 18.4-19.3 |
| 1910.. | 14.0 | 13.5-16.5 | 14.7-16.2 | 28.5 | 17.2-18.4 |
| 1909.. | 12.0 | 15.0-16.0 | 13.7-15.2 | 19.0-19.8 | 18.1-18.4 |
| April....1911.. | 12.0 | 12.0 | 17.2-18.2 | 20.6-22.7 | 17.2-18.4 |
| 1910.. | 13.5 | 13.5-16.0 | 14.7-16.2 | 23.0-27.4 | 18.4-20.2 |
| 1909.. | 12.0 | 13.5-14.5 | 14.2-15.7 | 18.7-19.8 | 18.1-19.3 |
| May....1911.. | 11.0 | 10.5 | 15.2-16.2 | 22.3-23.8 | 17.2-18.4 |
| 1910.. | 13.0 | 13.5 | 13.7-15.2 | 24.0-27.4 | 19.0-20.2 |
| 1909.. | 11.5 | 11.0-12.5 | 13.2-14.2 | 20.1-20.9 | 19.0-20.2 |
| June....1911.. | 13.0 | 13.0 | 14.2-15.2 | 21.6-22.7 | 16.7-18.2 |
| 1910.. | 13.0 | 13.5-14.5 | 13.2-15.2 | 21.6-25.9 | 14.9-16.7 |
| 1909.. | 11.0 | 12.0-13.5 | 14.7-15.7 | 20.3-21.4 | 16.7-18.1 |
| July....1911.. | 13.0 | 13.5 | 14.7-16.2 | 18.8-20.6 | 16.4-17.6 |
| 1910.. | 13.0 | 14.0-14.5 | 13.7-15.2 | 20.9-25.3 | 14.9-15.8 |
| 1909.. | 12.0 | 11.0-13.0 | 12.7-14.2 | 19.2-20.1 | 14.0-14.9 |
| August....1911.. | 12.0 | 14.0 | 15.2-16.2 | 17.9-20.1 | 16.7-17.6 |
| 1910.. | 13.5 | 15.5 | 14.2-16.2 | 21.1-25.1 | 17.5-18.4 |
| 1909.. | 12.5 | 12.0-14.0 | 11.1-12.2 | 22.5-24.8 | 12.3-13.2 |
| September....1911.. | 13.5 | 14.0 | 15.2-16.2 | 21.0-22.3 | 18.2-19.0 |
| 1910.. | 13.5 | 16.5 | 15.7-17.2 | 22.7-25.5 | 19.0-20.2 |
| 1909.. | 13.0 | 12.5-15.0 | 12.7-14.2 | 23.5 | 16.3-17.2 |
| October....1911.. | 13.5 | 15.0 | 14.2-16.2 | 21.6-23.1 | 16.4-17.6 |
| 1910.. | 14.0 | 16.5-17.0 | 14.7-15.2 | 22.7-27.0 | 17.2-18.4 |
| 1909.. | 13.5 | 12.5-15.5 | 12.2-13.2 | 23.1 | 15.8-17.2 |
| November....1911.. | 13.0 | 14.5 | 14.7-16.2 | 22.3-23.8 | 17.6-18.4 |
| 1910.. | 14.5 | 16.5-17.0 | 15.2-16.2 | 22.7-28.1 | 18.4-19.3 |
| 1909.. | 12.5 | 12.0-15.0 | 13.2-14.2 | 25.9 | 16.7-18.2 |
| December....1911.. | 12.5 | 15.0 | 13.7-15.2 | 22.3-23.8 | 16.4-17.6 |
| 1910.. | 14.0 | 16.5-17.0 | 15.2-16.2 | 24.2-28.1 | 16.7-18.4 |
| 1909.. | 12.0 | 12.0-15.5 | 15.2-16.2 | 26.6 | 16.7-18.4 |

## MUTTON.

Mutton was very much cheaper in Chicago and New York during 1911 than it was in the preceding year. The spring prices of mutton in 1910 were, in fact, unprecedentedly high; the top price of 16½

cents a pound at Chicago in May of that year being no less than 6 cents, or 36 per cent, higher than the corresponding figure for 1911. As was the case a year ago, New York mutton averaged fully 1 cent a pound lower than Chicago.

Paris mutton is the highest in the table, and the top price for March, 1911—22 cents a pound—is the highest quotation of the year for any kind of French meat listed in the tables. The highest price for lamb at Paris on the same day was 20 cents a pound, or 2 cents less than the mutton. It is rather singular that only in the last three months of the year does Parisian lamb command a higher price than the mutton.

*Wholesale prices, per pound, of fresh carcass mutton at stated home and foreign markets, 1909 to 1911, at monthly periods.*

| Date. | Chicago. | New York. | London. | Berlin. | Paris. |
|---|---|---|---|---|---|
| | Good sheep. | Choice sheep. | English. | Fat wethers. | First quality. |
| | *Cents.* | *Cents.* | *Cents.* | *Cents.* | *Cents.* |
| January.....1911.. | 9.0 | 8.0 | 11.1-12.7 | 15.1-16.6 | 17.6-19.3 |
| 1910.. | 10.0 | 9.0-10.0 | 10.2-12.2 | 15.8-16.6 | 17.5-18.9 |
| 1909.. | 9.5 | 9.0 | 11.1-13.2 | 14.0-14.9 | 19.0-20.2 |
| February.....1911.. | 9.0 | 8.0 | 11.7-13.2 | 14.9-15.1 | 18.4-19.9 |
| 1910.. | 10.0 | 9.5-11.0 | 11.2-12.7 | 14.7-15.8 | 17.5-18.4 |
| 1909.. | 10.5 | 9.5 | 9.6-10.6 | 13.2-14.0 | 17.2-18.4 |
| March.....1911.. | 9.0 | 8.0- 8.5 | 11.7-13.2 | 14.3-15.5 | 19.3-21.9 |
| 1910.. | 14.0 | 11.5-13.0 | 13.7-14.7 | 14.9-16.4 | 17.5-19.0 |
| 1909.. | 10.5 | 8.5- 9.5 | 10.1-12.2 | 13.6-14.0 | 17.5-18.4 |
| April.....1911.. | 10.5 | 10.0 | 11.1-12.7 | 14.7-15.5 | 18.4-20.2 |
| 1910.. | 16.0 | 15.0-15.5 | 13.7-15.2 | 14.5-16.0 | 18.4-19.8 |
| 1909.. | 10.5 | 10.0-11.5 | 11.1-12.7 | 13.4-13.8 | 18.4-19.8 |
| May.....1911.. | 10.5 | 9.0 | 11.1-12.7 | 15.1-16.4 | 19.3-21.1 |
| 1910.. | 16.5 | 15.0-15.5 | 12.7-14.7 | 15.1-16.6 | 18.4-19.3 |
| 1909.. | 10.5 | 10.0-11.0 | 13.2-14.7 | 14.2-14.7 | 18.4-19.3 |
| June.....1911.. | 10.5 | 10.0 | 10.6-12.7 | 16.0-17.7 | 19.3-21.1 |
| 1910.. | 14.0 | 10.0-11.0 | 13.2-15.2 | 16.4-17.9 | 16.7-18.1 |
| 1909.. | 13.5 | 11.5-13.0 | 12.7-15.2 | 15.3-15.8 | 19.3-20.7 |
| July.....1911.. | 10.5 | 8.0- 8.5 | 11.1-13.7 | 17.3-18.1 | 19.9-21.6 |
| 1910.. | 13.5 | 10.0-11.0 | 12.7-14.2 | 16.0-17.7 | 17.5-19.0 |
| 1909.. | 11.5 | 10.0-11.0 | 11.6-14.2 | 15.8-16.2 | 19.3-21.9 |
| August.....1911.. | 10.5 | 9.0 | 12.2-14.2 | 14.3-15.5 | 18.4-20.2 |
| 1910.. | 12.5 | 10.0-11.0 | 12.7-14.7 | 16.2-17.9 | 19.0-19.8 |
| 1909.. | 10.5 | 10.0-11.0 | 11.1-12.2 | 16.4-16.8 | 18.4-19.3 |
| September.....1911.. | 10.0 | 8.0 | 11.1-12.7 | 13.8-15.5 | 18.4-19.9 |
| 1910.. | 12.5 | 10.0 | 11.7-14.2 | 16.4-17.9 | 17.5-19.0 |
| 1909.. | 11.0 | 8.5- 9.5 | 11.1-12.7 | 16.6-16.8 | 17.5-19.3 |
| October.....1911.. | 11.0 | 9.0 | 11.1-12.7 | 13.0-14.7 | 18.4-19.3 |
| 1910.. | 12.5 | 9.0 | 11.2-12.2 | 14.9-16.2 | 15.8-18.1 |
| 1909.. | 9.5 | 8.5- 9.5 | 11.1-12.7 | 15.5-16.6 | 17.5-18.4 |
| November.....1911.. | 9.0 | 8.0 | 11.1-13.2 | 13.0-15.5 | 15.8-17.6 |
| 1910.. | 12.0 | 8.5 | 11.2-13.7 | 15.8-16.8 | 17.5-19.0 |
| 1909.. | 9.5 | 8.0- 9.0 | 9.1-11.1 | 15.5-16.6 | 17.2-18.4 |
| December.....1911.. | 9.0 | 7.0 | 10.1-12.2 | 14.3-18.6 | 14.9-16.7 |
| 1910.. | 12.0 | 8.0 | 10.7-12.7 | 13.0-15.1 | 15.8-17.5 |
| 1909.. | 9.5 | 8.0- 9.0 | 9.6-11.6 | 16.0-17.0 | 16.7-18.1 |

## LAMB.

During the early months of 1911 the prices of lamb in Chicago and New York followed the course of mutton in being much lower than the corresponding figures for 1910. There was a sharp rise in June, however, and high values approximating those of 1910 were maintained for several months, especially in New York.

As is usual, the early spring lamb in England commands a prohibitive price in March and April. The high mark of 24¼ cents a pound in March, 1911, was the same as that of the previous year. It may be noted that the highest prices for lamb in Berlin and Paris occur in midsummer.

*Wholesale prices, per pound, of fresh carcass lamb at stated home and foreign markets, 1909 to 1911, at monthly periods.*

| Dates. | Chicago. | New York. | London. | Berlin. | Paris. |
|---|---|---|---|---|---|
| | Round-dressed lambs. | Choice spring lambs. | Choice native. | Fat lambs. | Lambs, without head. |
| | *Cents.* | *Cents.* | *Cents.* | *Cents.* | *Cents.* |
| January.....1911.. | 10.5 | 11.5-12.0 | 19.3-22.3 | 16.6-18.1 | 10.5-19.0 |
| 1910.. | 15.0 | 12.0-14.0 | 17.2-19.2 | 17.9-18.6 | 12.3-18.4 |
| 1909.. | 12.5 | 12.0-13.5 | 20.3-22.3 | 15.8-16.2 | 15.8-21.9 |
| February.....1911.. | 10.5 | 10.5-11.0 | 19.3-22.3 | 16.4-18.1 | 11.4-18.4 |
| 1910.. | 14.5 | 12.0-14.5 | 17.2-19.2 | 16.4-17.5 | 13.2-17.5 |
| 1909.. | 14.0 | 11.5-12.5 | 17.2-19.3 | 14.0-14.5 | 15.8-19 3 |
| March.....1911.. | 11.0 | 10.5-11.0 | 23.3-24.3 | 16.0-17.3 | 14.9-20.2 |
| 1910.. | 15.0 | 13.0-16.0 | 22.3-24.3 | 16.6-17.5 | 10.5-21.9 |
| 1909.. | 14.0 | 11.5-13.0 | 19.3-22.3 | 14.2-14.7 | 15.8-19 3 |
| April.....1911.. | 12.0 | 12.5 | 19.3-22.3 | 16.0-17.3 | 14.0-19.3 |
| 1910.. | 17.5 | 17.0-18.0 | 18.2-23.3 | 16.2-17.1 | 14.0-19.3 |
| 1909.. | 14.0 | 12.5-14.0 | 19.3-22.3 | 14.0-14.3 | 15.8-20.2 |
| May.....1911.. | 11.5 | 12.5 | 17.2-21.3 | 16.4-17.3 | 13.2-19 9 |
| 1910.. | 17.5 | 17.5 | 16.2-20.3 | 16.6-17.7 | 12.3-18.4 |
| 1909.. | 13.5 | 13.0-14.5 | 19.3-22.3 | 14.9-15.1 | 15.8-20 2 |
| June.....1911.. | 14.5 | 15.0-17.5 | 17.2-21.3 | 18.1-19.0 | 10.5-20 7 |
| 1910.. | 15.5 | 17.0-18.0 | 15.2-18.2 | 18.6-19.0 | 8.7-17.5 |
| 1909.. | 16.0 | 15.0-17.0 | 16.2-20.9 | 16.0-16.2 | 15.8-21.0 |
| July.....1911.. | 14.0 | 14.5 | 15.2-18.2 | 18.6-19.9 | 10.5-21.1 |
| 1910.. | 15.5 | 14.5 | 14.2-17.2 | 17.9-18.6 | 13.2-19.0 |
| 1909.. | 16.0 | 12.5-15.5 | 14.2-16.2 | 16.4-16.6 | 15.8-21.0 |
| August.....1911.. | 14.0 | 14.0 | 15.2-16.7 | 16.4-18.1 | 13.2-20.2 |
| 1910.. | 14.5 | 14.0-14.5 | 14.2-16.2 | 18.4-19.0 | 10.5-19.3 |
| 1909.. | 14.5 | 10.0-13.0 | 12.2-12.4 | 17.0-17.5 | 15.8-20.2 |
| September.....1911.. | 13.5 | 13.0 | 13.2-16.2 | 16.0-17.3 | 10.5-19.3 |
| 1910.. | 14.0 | 13.5 | 14.2-16.2 | 18.4-19.0 | 12.3-19.0 |
| 1909.. | 14.0 | 11.0-13.5 | 12.2-14.2 | 17.3-17.9 | 15.8-20.2 |
| October.....1911.. | 11.5 | 12.0 | 13.2-14.2 | 15.1-17.3 | 10.5-19.3 |
| 1910.. | 14.5 | 13.5 | 13.2-14.2 | 16.8-17.3 | 10.5-17.5 |
| 1909.. | 13.0 | 11.0-13.0 | 11.2-13.2 | 17.3-17.7 | 15.8-21.0 |
| November.....1911.. | 10.5 | 11.0 | ..... | 16.0-18.1 | 12.3-21.1 |
| 1910.. | 13.2 | 12.0 | 12.2-13.2 | 16.8-17.9 | 10.5-20.2 |
| 1909.. | 12.0 | 10.0-12.0 | 10.2-12.2 | 17.3-17.7 | 15.8-21.0 |
| December.....1911.. | 10.0 | 9.5 | 18.2-20.3 | 16.8-18.6 | 12.3-20.2 |
| 1910.. | 11.5 | 12.0 | 12.2-13.7 | 15.8-17.5 | 10.5-19.3 |
| 1909.. | 13.0 | 11.0-13.0 | 10.1-12.2 | 18.1-18.6 | 15.8-21.0 |

## PORK.

American pork was higher in 1910 than ever before known. The table shows 14 cents a pound to have been reached at Chicago in April, September, and October of that year. High values ruled also in the early part of 1911, but a marked depression took place in the summer. It is of interest to note that New York prices were appreciably lower than those at Chicago during the greater part of 1911.

French pork is the highest in the table. During May and June, 1911, it touched 17½ cents a pound, although earlier in the year the prices were about on a par with London.

A study of this and the previous tables shows that pork is the only comparatively cheap meat at the German capital. In the first part of 1911 prices were similar to those at Chicago—in one or two instances even lower—but later in the year there was an advance, although the figures were always below those of 1910. It is therefore not surprising that the German people are large consumers of pork products. The pork consumption in Germany is estimated on page 264 of this volume to be 59 per cent of the entire meat consumption.

*Wholesale prices, per pound, of fresh carcass pork at stated home and foreign markets, 1909 to 1911, at monthly periods.*

| Dates. | Chicago. | New York. | London. | Berlin. | Paris. |
|---|---|---|---|---|---|
| | Dressed hogs. | Dressed hogs (medium weight). | Best (small and medium). | Choice (medium weight). | First quality. |
| | *Cents.* | *Cents.* | *Cents.* | *Cents.* | *Cents.* |
| January....1911.. | 11.0 -11.75 | 11.75 | 14.2-14.7 | 11.7-12.5 | 12.6-13.5 |
| 1910.. | 11.0 -11.5 | 12.25 | 14.7-15.2 | 15.8-16.1 | 11.4-12.3 |
| 1909.. | 7.5 - 8.5 | 8.25 | 11.6-12.2 | 15.1-15.3 | 13.2-14.9 |
| February....1911.. | 11.5 -12.0 | 11.6 | 13.7-14.7 | 12.5-12.7 | 13.7-14.4 |
| 1910.. | 11.25-11.75 | 12.0 | 14.7-15.2 | 14.8-15.1 | 11.4-12.1 |
| 1909.. | 57.5 - 8.5 | 8.9 | 11.6-12.7 | 14.9-15.1 | 12.3-13.2 |
| March....1911.. | 11.5 -13.0 | 10.75 | 14.7-15.2 | 12.3-12.7 | 14.6-15.5 |
| 1910.. | 12.5 -13.5 | 12.4 | 14.2-14.7 | 14.8-15.1 | 11.7-12.6 |
| 1909.. | 7.5 - 8.5 | 9.1 | 13.7-14.2 | 14.2-14.5 | 12.3-13.2 |
| April....1911.. | 12.5 -13.5 | 10.5 | 14.2-15.2 | 11.7-11.9 | 14.9-16.4 |
| 1910.. | 13.5 -14.0 | 12.6 | 15.2-16.2 | 15.2-15.5 | 13.0-14.0 |
| 1909.. | 8.5 - 9.5 | 9.5 | 13.7-14.2 | 14.0 | 11.9-12.8 |
| May....1911.. | 11.0 -12.0 | 9.1 | 13.7-14.2 | 11.7-12.1 | 16.7-17.6 |
| 1910.. | 13.0 -13.5 | 13.5 | 14.7-15.7 | 14.8 | 14.0-14.9 |
| 1909.. | 9.5 -10.0 | 10.0 | 12.2-13.2 | 13.2-13.4 | 12.3-13.2 |
| June....1911.. | 9.25- 9.75 | 9.1 | 12.2-13.2 | 12.1-12.5 | 16.7-17.6 |
| 1910.. | 12.0 -12.5 | 13.6 | 14.7-15.7 | 13.6-13.8 | 14.0-15.3 |
| 1909.. | 9.5 -10.0 | 10.25 | 13.7-14.7 | 13.6 | 12.3-13.2 |
| July....1911.. | 9.75-10.0 | 9.5 | 12.2-12.7 | 11.7-11.9 | 15.8-17.2 |
| 1910.. | 12.5 -13.5 | 13.5 | 14.7-15.2 | 13.6-13.8 | 14.9-15.8 |
| 1909.. | 10.0 -10.75 | 11.0 | 12.7-13.2 | 14.0-14.3 | 12.3-13.2 |

*Wholesale prices, per pound, of fresh carcass pork at stated home and foreign markets, 1909 to 1911, at monthly periods*—Continued.

| Dates. | Chicago. | New York. | London. | Berlin. | Paris. |
|---|---|---|---|---|---|
| | Dressed hogs. | Dressed hogs (medium weight). | Best (small and medium). | Choice (medium weight). | First quality. |
| | *Cents.* | *Cents.* | *Cents.* | *Cents.* | *Cents.* |
| August.....1911.. | 9.75-10.75 | 10.25 | 12.7-13.2 | 11.7-12.1 | 15.8-16.7 |
| 1910.. | 13.0 -13.75 | 13.0 | 15.2-15.7 | 14.2-14.5 | 14.9-15.8 |
| 1909.. | 10.75-11.25 | 11.25 | 12.2-12.7 | 15.5-15.8 | 13.5-14.6 |
| September.....1911.. | 10.75-11.75 | 11.25 | 12.7-13.2 | 13.2-13.4 | 15.8-16.7 |
| 1910.. | 13.0 -14.0 | 13.5 | 15.7-16.2 | 14.8 | 14.6-15.4 |
| 1909.. | 10.75-11.25 | 11.5 | 15.7-16.2 | 16.2-16.4 | 13.2-14.0 |
| October.....1911.. | 10.25-11.25 | 9.6 | 13.2-14.2 | 13.0-13.4 | 14.6-15.5 |
| 1910.. | 13.5 -14.0 | 13.6 | 14.2-15.2 | 14.8 | 13.5-14.4 |
| 1909.. | 11.0 -12.0 | 11.75 | 14.7-15.2 | 16.4-16.8 | 12.6-13.5 |
| November.....1911.. | 9.75-10.75 | 8.75 | 12.2-13.2 | 13.4-13.6 | 14.9-15.8 |
| 1910.. | 13.0 -13.75 | 13.0 | 15.2-16.2 | 14.8-15.1 | 13.2-14.0 |
| 1909.. | 10.5 -11.5 | 11.25 | 15.2-15.7 | 16.2-16.4 | 11-9-12.8 |
| December.....1911.. | 9.75-10.75 | 8.5 | 12.2-12.7 | 12.1-12.5 | 14.6-15.8 |
| 1910.. | 10.25-11.0 | 11.4 | 14.2-15.2 | 13.0 | 13.2-14.0 |
| 1909.. | 11.0 -11.5 | 11.25 | 15.2-15.7 | 15.1-15.5 | 11.6-12.5 |

## OUR FOREIGN TRADE IN ANIMALS AND ANIMAL PRODUCTS.

The main features of our foreign trade in farm animals and their products during the calendar year 1911, as compared with the preceding year, were an increase of $16,000,000 in the total value of the exports and a decrease of $7,000,000 in the total value of the imports. The exports in 1911 totaled $206,613,986, and the imports $142,900,292, leaving a balance of trade in our favor of $63,713,694. This exceeds the balance of 1910 by a little over $23,000,000, while the balance in 1909 was less than $13,000,000, the smallest on record. In the last two years, therefore, the exports have gained close upon $51,000,000 on the imports.

It should be noted, however, that the imports in 1909 were abnormally large, owing to the change in the tariff which took effect in that year. The exports of 1911 were notable because of the increased shipments of a number of meat products, particularly pork products. Fresh beef continues on the down grade, but there was a substantial increase in the number of cattle exported alive. The details of the trade for the past three years are shown in the tables below.

### EXPORTS.

The pork items totaled more than one-half in value of all the exports of animals and animal products in 1911. Lard alone amounted to fully one-fourth the total, the two other large items being bacon

and hams. Owing to the pronounced scarcity of hogs in 1910, the exports in that year were very limited, but the trade made such rapid strides in 1911 that the volume of 1909 was practically recovered. The table shows that practically every item on the list advanced in 1911. The 13,276,160 dozen eggs shipped out of the country in 1911 had an average value of 20⅓ cents per dozen.

*Exports of farm animals and their products, calendar years 1909–1911.*

[Compiled from the reports of the Department of Commerce and Labor.]

| Items. | 1909 | 1910 | 1911 | Value, 1911 |
|---|---|---|---|---|
| Animals: | | | | |
| Cattle.....number.. | 184,957 | 109,629 | 164,087 | $14,110,081 |
| Hogs.....do.... | 11,886 | 4,019 | 13,246 | 107,676 |
| Horses.....do.... | 23,428 | 29,359 | 30,291 | 4,308,789 |
| Mules.....do.... | 4,162 | 6,458 | 4,920 | 735,203 |
| Sheep.....do.... | 54,613 | 52,638 | 177,069 | 853,300 |
| All other, including fowls.....value [1].. | $282,692 | ..... | ..... | 274,944 |
| Dairy products: | | | | |
| Butter.....pounds.. | 2,925,730 | 3,104,175 | 6,374,988 | 1,359,249 |
| Cheese.....do.... | 3,501,214 | 2,768,681 | 13,781,176 | 1,719,302 |
| Milk, condensed.....do.... | ([2]) | 12,687,937 | 16,976,276 | 1,278,253 |
| Eggs.....dozen.. | 4,948,435 | 5,683,208 | 13,276,160 | 2,700,900 |
| Feathers.....value.. | $383,773 | ..... | ..... | 350,800 |
| Grease.....do.... | $5,107,620 | ..... | ..... | 5,866,700 |
| Hair.....do.... | $1,008,524 | ..... | ..... | 1,307,157 |
| Hides and skins.....pounds.. | 9,922,887 | 30,586,908 | 36,115,677 | 3,942,532 |
| Leather: | | | | |
| Sole.....do.... | 32,469,344 | 38,615,004 | 42,704,300 | 9,085,767 |
| Upper.....value.. | $23,797,800 | ..... | ..... | 1,871,844 |
| Meat products: | | | | |
| Beef— | | | | |
| Canned.....pounds.. | 16,649,712 | 11,503,037 | 11,248,543 | 1,311,234 |
| Fresh.....do.... | 93,742,451 | 55,538,924 | 28,782,481 | 2,905,412 |
| Salted, etc.....do.... | 43,943,209 | 35,335,923 | 42,304,538 | 3,181,044 |
| Pork— | | | | |
| Canned.....do.... | 5,628,928 | 3,715,803 | 5,057,999 | 596,379 |
| Fresh.....do.... | 2,417,185 | 907,229 | 2,231,661 | 256,096 |
| Pickled.....do.... | 46,742,815 | 41,488,829 | 50,929,350 | 4,875,795 |
| Bacon.....do.... | 212,551,071 | 128,269,744 | 198,112,203 | 24,185,672 |
| Hams and shoulders.....do.... | 195,765,704 | 131,181,642 | 189,615,032 | 23,337,395 |
| Lard.....do.... | 458,261,434 | 368,831,681 | 552,429,865 | 54,504,681 |
| Lard compounds.....do.... | 73,245,815 | 71,993,638 | 69,484,042 | 6,022,309 |
| Mutton.....do.... | 1,640,572 | 1,997,099 | 2,573,653 | 246,221 |
| Oleo oil and neutral lard.....do.... | 161,273,364 | 115,161,034 | 215,876,093 | 21,126,301 |
| Oleomargarin.....do.... | 3,104,541 | 3,654,670 | 3,833,169 | 404,727 |
| Tallow.....do.... | 50,113,092 | 16,262,289 | 45,659,263 | 2,810,574 |
| Sausage.....do.... | 7,421,836 | 3,947,900 | 6,278,553 | 810,135 |
| Sausage casings .....value.. | ([2]) | $35,467,821 | $40,640,386 | 5,596,697 |
| Poultry and game.....do.... | $827,324 | ..... | ..... | 971,554 |
| Animal oil.....gallons.. | 2,167,846 | 1,322,293 | 1,167,681 | 876,940 |
| All other meat products.....value.. | $2,645,921 | ..... | ..... | 2,722,317 |
| Total annual value..... | $212,943,904 | $190,650,021 | $206,613,986 | 206,613,986 |

[1] Where values are given the quantities are not stated.

[2] Quantity for 1909 not stated.

## IMPORTS.

Hides and wool form the great bulk of our imports of animal products. The various classes of hides in 1911 amounted to 58 per cent of the total imports. There was a continued decrease from the high mark of 1909 in every item except calfskins, which increased from 53,157,553 pounds in 1910 to 82,628,078 pounds in 1911.

We import an increasingly large amount of foreign cheese, the quantity received in 1911 being 45,447,329 pounds, with a valuation of $8,250,530. This equals an average price per pound of 18.2 cents. About three-fourths of this cheese comes from Italy and Switzerland, the former country supplying the somewhat larger share.

*Imports of farm animals and their products, calendar years 1909–1911.*

[Compiled from the reports of the Department of Commerce and Labor.]

| Items. | 1909 | 1910 | 1911 | Value, 1911 |
|---|---|---|---|---|
| Animals: | | | | |
| Cattle.....number.. | 153,902 | 211,230 | 252,413 | $3,915,888 |
| Horses.....do.... | 9,580 | 10,714 | 8,469 | 2,191,304 |
| Sheep.....do.... | 127,019 | 56,201 | 23,063 | 153,459 |
| All other, including fowls.....value [1].. | $712,756 | ..... | ..... | 761,652 |
| Bones, hoofs, and horns.....do.... | $945,028 | ..... | ..... | 1,019,138 |
| Bristles.....pounds.. | 4,059,222 | 3,699,827 | 3,235,071 | 2,814,042 |
| Dairy products: | | | | |
| Butter.....pounds.. | 1,416,633 | 1,209,473 | 1,004,549 | 226,829 |
| Cheese.....do.... | 37,795,506 | 43,966,873 | 45,447,329 | 8,250,530 |
| Cream [2].....gallons.. | ..... | 1,858,652 | 1,202,016 | 968,669 |
| Feathers, crude.....value.. | $6,603,656 | ..... | ..... | 5,210,884 |
| Glue.....pounds.. | 7,718,780 | 9,005,853 | 8,094,051 | 704,322 |
| Grease and oils.....value.. | $1,050,053 | ..... | ..... | 910,746 |
| Hair, animal, unmanufactured.....do.... | $3,627,565 | ..... | 15,078,568 | 3,013,528 |
| Hides and skins: | | | | |
| Cattle hides.....pounds.. | 279,044,262 | 221,969,098 | 170,652,626 | 25,227,819 |
| Calf and kip.....do.... | 47,062,988 | 53,157,553 | 82,628,078 | 21,226,228 |
| Goatskins.....do.... | 115,167,176 | 100,719,480 | 91,065,576 | 21,762,359 |
| Sheepskins.....do.... | 63,771,930 | 59,669,263 | 57,435,906 | 9,225,086 |
| All other.....do.... | 67,730,147 | 23,562,879 | 23,097,230 | 4,014,856 |
| Hide cuttings.....value.. | $1,506,756 | ..... | ..... | 1,655,679 |
| Meat products: | | | | |
| Sausage casings.....do.... | $2,388,738 | ..... | ..... | 2,806,702 |
| All other.....do.... | $778,759 | ..... | ..... | 1,271,150 |
| Wool, raw.....pounds.. | 312,131,171 | 180,134,981 | 155,922,510 | 25,479,422 |
| Total value..... | $200,407,539 | $150,178,769 | $142,900,292 | 142,900,292 |

[1] Where values are given the quantities are not stated.
[2] Not separately enumerated until July 1, 1910.

## LEGAL STANDARDS FOR DAIRY PRODUCTS.

In the following statement, prepared in the Dairy Division, are given the standards for dairy products as established by law in the several States and Territories. The percentages stated represent

minimum standards in all cases, unless otherwise expressed. The department publishes these figures as given by various State authorities, but does not guarantee the correctness of the standards quoted.

*Legal standards for dairy products, 1911.*

| States. | Milk. | | | Skim milk. | Cream. | Butter. | Whole milk cheese. | Condensed milk. | | Ice cream (plain). | Ice cream (fruit and nut). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total solids. | Solids not fat. | Fat. | Total solids. | Fat. | Fat. | Fat. | Total solids. | Fat. | Fat. | Fat. |
| | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* |
| Alabama | No State standards. | | | | | | | | | | |
| Arizona | No State standards. | | | | | | | | | | |
| Arkansas | Federal rulings adopted. | | | | | | | | | | |
| California | 11.5 | 8.5 | 3.0 | 8.8 | 18.0 | 80.0 | [1] 50 | ([2]) | ([2]) | 12 | ..... |
| Colorado | ..... | ..... | 3.0 | ..... | [3] 16.0 | 80.0 | [1] 50 | ..... | ..... | 14 | 12 |
| Connecticut | 11.75 | 8.5 | 3.25 | ..... | 16.0 | ..... | ..... | ..... | ..... | ..... | ..... |
| Delaware | No State standards. | | | | | | | | | | |
| District of Columbia | 12.5 | 9.0 | 3.5 | 9.3 | 20.0 | 83.0 | ..... | ..... | ..... | ..... | ..... |
| Florida | 11.75 | 8.5 | 3.25 | 9.25 | 18.0 | 82.5 | [1] 50 | [4] 28.0 | [4] 7.7 | 12 | ..... |
| Georgia | 11.75 | 8.5 | 3.25 | 9.25 | 18.0 | 82.5 | [1] 50 | 28.0 | [1] 27.66 | 14 | 12 |
| Hawaii [5] | 11.5 | 8.5 | 3.0 | ..... | ..... | ..... | ..... | 28.0 | 7.7 | ..... | ..... |
| Idaho | 11.2 | 8.0 | 3.2 | 9.3 | 18.0 | 82.5 | 30 | ([2]) | ([2]) | 14 | 12 |
| Illinois | 11.5 | 8.5 | 3.0 | 9.25 | 18.0 | 82.5 | [1] 50 | ([2]) | ([2]) | 8 | ..... |
| Indiana | ..... | 8.5 | 3.25 | 9.25 | 18.0 | 82.5 | [1] 50 | 28.0 | [1] 27.5 | 8 | ..... |
| Iowa | 12.0 | ..... | 3.0 | ..... | 16.0 | [6] 80.0 | ..... | ..... | ..... | 12 | ..... |
| Kansas | 11.75 | 8.5 | 3.25 | 9.25 | [3] 18.0 | 80.0 | [1] 50 | ([2]) | ([2]) | 14 | 12 |
| Kentucky | 12.5 | 8.5 | 3.25 | 9.25 | 18.0 | 82.5 | [1] 50 | 28.0 | [1] 27.66 | 14 | 12 |
| Louisiana | ..... | 8.5 | 3.5 | 8.0 | 18.0 | ..... | ..... | ([2]) | ([2]) | ..... | ..... |
| Maine | 11.75 | 8.5 | 3.25 | ..... | 18.0 | ..... | ..... | ..... | ..... | ..... | ..... |
| Maryland | 12.5 | ..... | 3.5 | 9.25 | 18.0 | ..... | ..... | ([2]) | ([2]) | 4 | 6 |
| Massachusetts | 12.15 | ..... | 3.35 | 9.3 | 15.0 | ..... | ..... | ..... | ..... | ..... | ..... |
| Michigan | 12.5 | ..... | 3.0 | ..... | ..... | ..... | ..... | ..... | ..... | 12 | ..... |
| Minnesota | 13.0 | 9.75 | 3.25 | ..... | 20.0 | ..... | [1] 45 | ([2]) | ([2]) | 12 | ..... |
| Mississippi | No State standards. | | | | | | | | | | |
| Missouri | 12.0 | 8.75 | 3.25 | 9.25 | 18.0 | 82.5 | [1] 50 | 28.0 | 7.76 | 14 | ..... |
| Montana | 11.75 | 8.5 | 3.25 | ..... | 20.0 | 82.5 | [1] 50 | ..... | ..... | 14 | ..... |
| Nebraska | ..... | ..... | 3.0 | ..... | 18.0 | ..... | ..... | ..... | ..... | 14 | 12 |
| New Hampshire | 12.0 | ..... | ..... | 8.5 | 18.0 | 80.0 | ..... | ..... | ..... | [7] 14 | ..... |
| New Jersey | 11.5 | ..... | 3.0 | ..... | 16.0 | ..... | ..... | ..... | ..... | ..... | ..... |
| New Mexico | No State standards. | | | | | | | | | | |
| New York | 11.5 | ..... | 3.0 | ..... | 18.0 | ..... | ..... | ([8]) | [1] 25.0 | ..... | ..... |
| Nevada | 11.75 | 8.5 | 3.25 | 9.25 | 18.0 | 82.5 | [1] 50 | 26.5 | 7.8 | 14 | ..... |
| North Carolina | 11.75 | 8.5 | 3.25 | 9.25 | 18.0 | 82.5 | [1] 50 | 28.0 | [1] 27.5 | 14 | 12 |
| North Dakota | 12.0 | 9.0 | 3.0 | ..... | 15.0 | ..... | ..... | ..... | ..... | 14 | ..... |
| Ohio | 12.0 | ..... | 3.0 | ..... | ..... | [9] 80.0 | ..... | ([10]) | [1] 25.0 | ..... | ..... |
| Oklahoma | 12.51 | 9.5 | 3.0 | ..... | 18.0 | 81.5 | ..... | ..... | ..... | 14 | ..... |

[1] Percentage of fat based on total solids.
[2] Fat, 7.8 per cent; total solids plus fat, 34.3 per cent.
[3] For buttermaking, 25 per cent fat.
[4] This standard for sweetened condensed milk: "Evaporated milk," solids, 24 per cent; fat, 7.8 per cent.
[5] No report; 1910 standard given.
[6] By weight.
[7] Not more than 0.2 per cent "filler."
[8] Must correspond to 11.5 per cent solids in crude milk.
[9] If artificially colored.
[10] Must correspond to 12 per cent solids in crude milk.

*Legal standards for dairy products, 1911*—Continued.

| States. | Milk. | | | Skim milk. | Cream. | Butter. | Whole milk cheese. | Condensed milk. | | Ice cream (plain). | Ice cream (fruit and nut). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total solids. | Solids not fat. | Fat. | Total solids. | Fat. | Fat. | Fat. | Total solids. | Fat. | Fat. | Fat. |
| | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* |
| Oregon | ..... | 9.0 | 3.2 | ..... | 20.0 | ..... | 30.0 | (1) | (1) | 12 | ..... |
| Pennsylvania | 12.0 | ..... | 3.25 | ..... | 18.0 | ..... | 32.0 | ..... | ..... | 8 | 6 |
| Porto Rico | 12.0 | 9.0 | 3.0 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Rhode Island | 12.0 | ..... | 2.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| South Carolina | No State standards. | | | | | | | | | | |
| South Dakota | ..... | 8.5 | 3.25 | 9.25 | 18.0 | 80.0 | [2] 50 | 28.0 | [2] 27.5 | 14 | 12 |
| Tennessee | ..... | 8.5 | 3.25 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Texas | ..... | 8.5 | 3.25 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Utah | 12.0 | 9.0 | 3.2 | 9.0 | 18.0 | 80.0 | [2] 50 | (3) | (3) | 14 | 12 |
| Vermont | [4] 12.5 | 9.25 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Virginia | 11.75 | 8.5 | 3.25 | 9.25 | 18.0 | 82.5 | ..... | (3) | (3) | 8 | ..... |
| Washington | 12.0 | 8.75 | 3.25 | 9.3 | 18.0 | ..... | 30 | ..... | ..... | ..... | ..... |
| West Virginia | No State standards. | | | | | | | | | | |
| Wisconsin | ..... | 8.5 | 3.0 | 9.0 | 18.0 | 82.5 | [2] 50 | 28.0 | 8.0 | 14 | ..... |
| Wyoming | ..... | 8.5 | 3.25 | 9.25 | 18.0 | 82.5 | [2] 50 | 28.0 | (5) | 14 | 12 |

[1] 23–24 per cent solids; 7.9 per cent fat; 24–25 per cent solids, 7.8 per cent fat; 25–26 per cent solids, 7.7 per cent fat; 26 per cent solids, 7.6 per cent fat.

[2] Percentage of fat based on total solids.

[3] Fat, 7.8 per cent; total solids plus fat, 34.3 per cent.

[4] In May and June, solids 12 per cent.

[5] Fat, 27.5 per cent of total solids.

## STATE LIVE-STOCK SANITARY OFFICERS.

United States Live Stock Sanitary Association: President, Dr. J. F. De Vine, Goshen, N. Y.; vice presidents, Fred F. Walker, Boston, Mass.; Dr. Charles Keane, Sacramento, Cal.; G. T. Bryan, Guthrie, Okla.; Dr. W. F. Crewe, Devils Lake, N. Dak.; Dr. M. H. Reynolds, University Farm, St. Paul, Minn.; secretary and treasurer, J. J. Ferguson, Union Stock Yards, Chicago, Ill.

*Alabama.*—State live-stock sanitary board: R. F. Kolb, chairman and commissioner of agriculture, Auburn; Prof. Dan T. Gray, Auburn Polytechnic Institute, Auburn; Dr. C. A. Cary, secretary and State veterinarian, Auburn.

*Arizona.*—State live-stock sanitary board: J. A. Johnson, chairman, Williams; I. L. Dedman, Christy; J. M. Roanstedt, Tucson; S. B. Bradner, secretary, Phoenix; Dr. W. E. Severn, State veterinarian, Phoenix.

*Arkansas.*—Dr. J. F. Stanford, veterinarian, Agricultural College and Experiment Station, Fayetteville.

*California.*—Dr. Charles Keane, State veterinarian, Sacramento.

*Colorado.*—State board of stock-inspection commissioners: A. K. Stevens, president, Iola; H. W. Potter, treasurer, La Junta; E. McCrillis, secretary, Denver; Dr. W. W. Yard, State veterinarian, Denver.

*Connecticut.*—Heman O. Averill, commissioner of domestic animals, Hartford.

*Delaware.*—State live-stock sanitary board: O. A. Newton, president, Bridgeville; Newton L. Grubb, vice president, Grubbs; Edward W. Jenkins, Dover; Dr. J. R. Kuhns, secretary and State veterinarian, Dover.

*Florida.*—Dr. Charles F. Dawson, veterinarian to State board of health, Jacksonville.

*Georgia.*—Dr. Peter F. Bahnsen, State veterinarian, Atlanta.

*Hawaii.*—Dr. V. A. Nörgaard, territorial veterinarian, Honolulu.

*Idaho.*—State live-stock sanitary board: L. L. Ormsby, president, Boise; Charles H. Baird, Forest; Thomas C. Stanford, Carey; William H. Larkins, Turner; Clay Vance, Dickey; Arthur Pence, Hot Springs; Charles W. Leaf, Fernwood; Dr. J. H. Weber, State veterinarian, Boise.

*Illinois.*—State board of live-stock commissioners: Henry J. Beer, Blue Island; T. F. Russell, Pana; Philip S. Haner, Taylorville; C. A. Lowery, secretary, Springfield; Dr. James M. Wright, State veterinarian, 1827 Wabash Avenue, Chicago, Ill.

*Indiana.*—Dr. W. E. Coover, State veterinarian, Indianapolis.

*Iowa.*—Dr. James I. Gibson, State veterinarian, Des Moines.

*Kansas.*—J. H. Mercer, live-stock sanitary commissioner, Topeka.

*Kentucky.*—J. W. Newman, chairman State live-stock sanitary board, Frankfort; Dr. Robert Graham, State veterinarian, Louisville.

*Louisiana.*—Dr. E. Pegram Flower, State veterinarian and secretary of State live-stock sanitary board, Baton Rouge.

*Maine.*—V. W. Carll, State live-stock sanitary commissioner, Augusta; R. S. Smith, dairy inspector, Augusta.

*Maryland.*—State live-stock sanitary board: Wade H. D. Warfield, Sykesville; E. Gittings Merryman, Cockeysville; Charles W. Simpers, North East; Dr. F. H. Mackie, chief veterinary inspector, 1035 Cathedral Street, Baltimore.

*Massachusetts.*—Fred Freeland Walker, chief of cattle bureau, State board of agriculture, 136 State House, Boston.

*Michigan.*—State live-stock sanitary commission: C. A. Tyler, Coldwater; H. H. Hinds, Stanton; T. F. Marston, Bay City; Dr. Ward Giltner, State veterinarian, East Lansing.

*Minnesota.*—State live-stock sanitary board: Dr. C. E. Cotton, president, Minneapolis; C. A. Nelson, vice president, Fridley; Dr. M. H. Reynolds, University Farm, St. Paul; P. H. Grogan, St. James; Carl Sholin, Milaca; Dr. S. H. Ward, secretary and executive officer, Old Capitol, St. Paul.

*Mississippi.*—R. L. Shields, secretary, State live-stock sanitary board, Agricultural College; Dr. James Lewis, State veterinarian, Agricultural College.

*Missouri.*—Dr. S. Sheldon, State veterinarian, Columbia.

*Montana.*—Dr. William Treacy, chairman State live-stock sanitary board; Dr. M. E. Knowles, State veterinarian, Helena.

*Nebraska.*—Dr. A. Bostrom, deputy State veterinarian, Lincoln.

*Nevada.*—Dr. T. F. Richardson, State veterinarian, Fallon; Stan. C. Mitchell, secretary State sheep commission, Reno.

*New Hampshire.*—State cattle commission: N. J. Bachelder, Concord; Dr. Irving A. Watson, Concord; Richard Pattee, Plymouth.

*New Jersey.*—State board of health: John H. Capstick, president, Montville; Dr. Bruce S. Keator, secretary, Asbury Park.

State tuberculosis commission: Hon. Joseph S. Frehlinghuysen, president, Raritan; Franklin Dye, secretary, Trenton.

*New Mexico.*—Cattle sanitary board: C. L. Ballard, president, Roswell; W. H. Jack, Silver City; W. W. Cox, Organ; B. F. Pankey, Lamy; W. D. McDonald, Carrizozo; W. J. Linwood, secretary, Albuquerque.

Sheep sanitary board: Harry F. Lee, secretary, Albuquerque.

*New York.*—Dr. J. G. Wills, chief veterinarian, department of agriculture, Albany.

*North Carolina.*—Dr. W. G. Chrisman, State veterinarian, Raleigh.

Committee on live-stock sanitary control and animal husbandry: A. Cannon, chairman, Horse Shoe; K. W. Barnes, Lucama; W. J. Shuford, Hickory; J. P. McRae, Laurinburg.

*North Dakota.*—State live-stock sanitary board: W. L. Richards, Dickinson; T. B. Dawson, La Moure; Andrew Veitch, Grand Forks; J. W. Roberson, Coal Harbor; E. J. Walsh, Willow City. Dr. W. F. Crewe, State veterinarian, Devils Lake. Dr. L. Van Es, bacteriologist, Fargo.

*Ohio.*—Dr. Paul Fischer, State veterinarian, Reynoldsburg; Dr. F. A. Zimmer, chief field veterinarian, Williamsburg; Morgan B. Lamb, specialist in tuberculosis and cattle diseases, Columbus.

*Oklahoma.*—Leslie Bush, superintendent of live-stock inspection, Oklahoma. Drs. J. K. Callicotte and Ben Dobkins, veterinarians to State board of agriculture, Oklahoma.

*Oregon.*—State board of health: Dr. A. C. Smith, president, Portland; Dr. C. S. White, secretary, Selling Building, Portland.

Board of sheep commissioners: Charles Cleveland, president, Gresham; Herbert Boylen, secretary, Pendleton; H. C. Rooper, Antelope.

Dr. J. F. Morel, State veterinarian, Portland. Dr. W. H. Lytle, State sheep inspector, Pendleton.

*Pennsylvania.*—State live-stock sanitary board: Gov. John K. Tener, president; James Foust, vice president; Dr. C. J. Marshall, secretary and State veterinarian; Dr. T. E. Munce, deputy State veterinarian, all of Harrisburg; Carl W. Gay, Philadelphia.

*Porto Rico.*—Dr. Thomas A. Allen, veterinary inspector, health office, San Juan.

*Rhode Island.*—Dr. John S. Pollard, State veterinarian, Providence. John J. Dunn, secretary State board of agriculture, Providence.

*South Carolina.*—Dr. M. Ray Powers, State veterinarian, Clemson College.

*South Dakota.*—Dr. Thomas H. Hicks, State veterinarian, Milbank.

*Tennessee.*—T. F. Peck, commissioner of agriculture, Nashville. Dr. G. R. White, State live-stock inspector, Nashville.

*Texas.*—W. N. Waddell, chairman State live-stock sanitary commission, Fort Worth. Dr. E. R. Forbes, State veterinarian, Fort Worth. J. A. Whitten, State sheep inspector, Eldorado.

*Utah.*—Dr. A. Carrington Young, State veterinarian, McIntyre Building, Salt Lake City.

State board of sheep commissioners: L. R. Anderson, president, Salt Lake City; Arthur A. Callister, secretary, Salt Lake City.

*Vermont.*—Fred L. Davis, State cattle commissioner, White River Junction.

*Virginia.*—Dr. J. G. Ferneyhough, State veterinarian, Burkeville.

State live-stock sanitary board: L. E. Johnson, chairman, Roanoke; P. F. St. Clair, Bane; B. F. Kirkpatrick, Lynchburg; J. C. Carrington, Charlotte Court House; P. B. Barringer, Blacksburg; C. I. Wade, secretary, Christiansburg.

*Washington.*—Dr. S. B. Nelson, State veterinarian, Spokane.

*West Virginia.*—John M. Millan, secretary State board of agriculture, Charleston.

*Wisconsin.*—Dr. O. H. Eliason, State veterinarian, Madison.

*Wyoming.*—Dr. B. F. Davis, State veterinarian, Cheyenne.

State board of live-stock commissioners: J. C. Underwood, Underwood; Thomas Bell, Lusk; Fred G. S. Hesse, Buffalo.

State board of sheep commissioners: Frank S. King, Laramie; J. J. Bentley, Sheridan; Lewis Barker, Casper; Dr. H. S. Eakins, secretary-treasurer, Cheyenne.

## LIST OF ACCREDITED VETERINARY COLLEGES.

The following is a list of accredited veterinary colleges,[1] graduates of which are eligible for the civil-service examination for the position of veterinary inspector in the Bureau of Animal Industry, under the terms of the regulations governing entrance to the veterinary inspector examination (Bureau of Animal Industry Circular 150):

Alabama Polytechnic Institute, College of Veterinary Medicine.
Chicago Veterinary College.
Cincinnati Veterinary College.
Colorado State College, Division of Veterinary Medicine.
George Washington University, College of Veterinary Medicine.
Grand Rapids Veterinary College.[2]
Indiana Veterinary College.
Iowa State College, Division of Veterinary Medicine.
Kansas City Veterinary College.
Kansas State Agricultural College, Veterinary Department.
McKillip Veterinary College.
New York-American Veterinary College
New York State Veterinary College.
Ohio State University, College of Veterinary Medicine.
St. Joseph Veterinary College.[3]
San Francisco Veterinary College.
State College of Washington, Veterinary Department.
Terre Haute Veterinary College.
United States College of Veterinary Surgeons.[4]
University of Pennsylvania, School of Veterinary Medicine.
University of Toronto, Ontario Veterinary College, to include only those graduated during or prior to 1897.

Graduates of the following named colleges, which are not now in session, will be admitted to examinations:

Columbian University, Veterinary School, Washington, D. C.
Harvard University, School of Veterinary Medicine, Boston, Mass.
McGill University, Veterinary Department, Montreal, Canada.
National Veterinary College, Washington, D. C.

Graduates of the following named foreign colleges will be admitted to examinations:

Glasgow Veterinary College, Glasgow, Scotland.
Royal Veterinary College, London, England.
Royal Veterinary College of Ireland, Dublin, Ireland.
Royal (Dick) Veterinary College, Edinburgh, Scotland.
The New Veterinary College, Liverpool, England.
Veterinary College of Lemberg, Austria.
University of Melbourne, Veterinary School, Melbourne, Australia.

[1] This list is subject to change. The failure of any college to comply with the provisions of the regulations will necessitate removal from the list.

[2] To include only those graduates who have pursued the study of veterinary medicine at this college or in some other accredited college for three years.

[3] Matriculates of 1910, in addition to the regular course, will be required to take one year's additional instruction at this college. Graduates prior to 1914 will be required to have had one year's practice and to take an additional year's instruction at this college.

[4] Graduates of 1910 and 1911 will be required to present a certificate showing attendance for an additional session at this or some other accredited veterinary college.

## ANIMAL DISEASES IN FOREIGN COUNTRIES.

Statistics of contagious animal diseases in foreign countries are shown in the series of tables next following. A number of these countries, particularly the European, maintain sanitary supervision over their live stock and issue periodical reports thereon which are received in this bureau. The reports for the year 1911, with comparisons, have been tabulated for each of the following countries: Argentina, Austria, Belgium, Canada, Denmark, France, Germany, Great Britain and Ireland, Hungary, India, Italy, the Netherlands, Norway, Sweden, and Switzerland.

The great disturbing factor in the European situation in 1911 was foot-and-mouth disease. Two years ago the whole of western and central Europe was practically free from this troublesome malady, but the disease is so extremely contagious that it continued to appear from time to time in spite of strict vigilance. The visitation of 1911 was unusually severe. During the summer, when the epizootic was at its height, the whole of continental Europe was overrun with it. Even England, where the most strenuous efforts are put forth to exclude it, had to deal with no less than 19 outbreaks during the year.

The rapidity with which foot-and-mouth disease can invade the farm stock in a country, notwithstanding measures to control it (short of slaughtering all infected animals) by a well-organized sanitary force, is illustrated by the Belgian reports. (See table on page 290). Here the disease first appeared in February, 1911, and did not make serious headway until June, yet at the end of the year the total number of animals reported infected amounted to approximately 14 per cent of all the susceptible animals in Belgium.

The details, showing whenever possible the monthly and annual status of animal diseases in each country, follow:

### AUSTRIA.

Aside from foot-and-mouth disease the situation regarding animal diseases in Austria during 1911 was quite favorable. Compared with the preceding year nearly all the other diseases were less prevalent, hog cholera and swine plague particularly so. There was, however, some increase in sheep scab.

Austria had been entirely free from foot-and-mouth disease during the first six months of 1910, but later in the year the contagion spread with great rapidity. In the spring of 1911 the infection had moderated very much, only, however, to break out with renewed force in the summer. In the fall the whole country was overridden with the disease.

*Number of premises infected with contagious diseases of animals in Austria at monthly periods during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Foot-and-mouth disease | 34,074 | 28,561 | 21,248 | 8,642 | 5,028 | 7,531 |
| Anthrax | 13 | 17 | 12 | 16 | 16 | 15 |
| Blackleg | 2 | 4 | 5 | 4 | 2 | 9 |
| Glanders | 11 | 10 | 8 | 14 | 11 | 8 |
| Sheep pox | 4 | ..... | ..... | ..... | ..... | ..... |
| Coital exanthema | 18 | 23 | 27 | 76 | 140 | 171 |
| Scab: | | | | | | |
| Solipeds | 18 | 46 | 52 | 59 | 60 | 65 |
| Sheep | 47 | 218 | 219 | 215 | 217 | 217 |
| Goats | 3 | 12 | 28 | 25 | 28 | 37 |
| Rabies | 25 | 27 | 35 | 35 | 28 | 33 |
| Hog cholera and swine plague | 1,369 | 1,036 | 858 | 560 | 487 | 449 |
| Erysipelas of swine | 61 | 36 | 21 | 30 | 134 | 195 |

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| Foot-and-mouth disease | 19,519 | 40,123 | 98,165 | 110,382 | 103,934 | 57,673 |
| Anthrax | 21 | 17 | 68 | 19 | 9 | 13 |
| Blackleg | 21 | 30 | 21 | 11 | 10 | 5 |
| Glanders | 6 | 9 | 7 | 9 | 6 | 9 |
| Septicemia hemorrhagica | 2 | ..... | 3 | 1 | ..... | 2 |
| Coital exanthema | 123 | 43 | 21 | 22 | 17 | 19 |
| Scab: | | | | | | |
| Solipeds | 62 | 59 | 39 | 37 | 26 | 21 |
| Sheep | 22 | 18 | 17 | 19 | 19 | 21 |
| Goats | 20 | 16 | 13 | 12 | 9 | 8 |
| Rabies | 38 | 29 | 22 | 15 | 30 | 20 |
| Hog cholera and swine plague | 483 | 447 | 467 | 430 | 474 | 449 |
| Erysipelas of swine | 435 | 494 | 415 | 332 | 232 | 186 |

The following diseases are scheduled in Austria for which no cases were reported in 1911: Cattle plague, pleuropneumonia, and dourine.

## BELGIUM.

Foot-and-mouth disease reappeared in Belgium in February, 1911, and gradually assumed very serious proportions. The contagion reached its height in July, a total of 153,609 cases being reported for that month. The situation subsequently showed much improvement, and by December the monthly total had fallen to 7,598 cases. The totals for the year represent an infection of approximately 15 per cent of all the cattle in Belgium, 13 per cent of all the swine, 7 per cent of the sheep, and 0.7 per cent of the goats.

The figures for the other diseases compare favorably with those of 1910. It is worthy of note that glanders appears to have been entirely eradicated in 1911, no case having been reported since March of that year.

*Cases of contagious diseases of animals in Belgium during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Glanders and farcy | ..... | 1 | 1 | ..... | ..... | ..... |
| Foot-and-mouth disease: | | | | | | |
| Cattle | ..... | 102 | 354 | 936 | 7,973 | 47,579 |
| Sheep | ..... | 72 | 1 | 106 | 360 | 2,814 |
| Goats | ..... | 1 | 7 | 18 | 29 | 177 |
| Swine | ..... | 34 | 74 | 579 | 3,015 | 18,193 |
| Rabies: | | | | | | |
| Cases | 1 | 1 | 10 | 4 | 10 | 16 |
| Suspects (slaughtered) | 2 | 3 | 6 | 8 | 53 | 21 |
| Anthrax | 68 | 63 | 101 | 81 | 100 | 40 |
| Blackleg | 13 | 7 | 10 | 11 | 14 | 16 |
| Foot rot of sheep | ..... | ..... | ..... | 9 | 2 | 130 |
| Tuberculosis: | | | | | | |
| Condemned | 364 | 347 | 414 | 379 | 410 | 371 |
| Passed for food | 1,984 | 1,876 | 2,239 | 1,863 | 1,824 | 1,873 |

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|---|---|---|---|---|---|---|---|
| Glanders and farcy | ..... | ..... | ..... | ..... | ..... | ..... | 2 |
| Foot-and-mouth disease: | | | | | | | |
| Cattle | 93,882 | 66,871 | 36,542 | 16,630 | 11,643 | 4,646 | 287,158 |
| Sheep | 6,265 | 3,444 | 1,659 | 1,917 | 1,056 | 224 | 17,918 |
| Goats | 560 | 522 | 225 | 130 | 58 | 35 | 1,762 |
| Swine | 52,902 | 34,695 | 24,398 | 14,173 | 8,557 | 2,693 | 159,313 |
| Rabies: | | | | | | | |
| Cases | 15 | 8 | 9 | 5 | 9 | 15 | 103 |
| Suspects (slaughtered) | 23 | 2 | 26 | 3 | 3 | 7 | 157 |
| Anthrax | 43 | 74 | 82 | 63 | 41 | 49 | 805 |
| Blackleg | 22 | 23 | 23 | 17 | 16 | 16 | 188 |
| Sheep scab | ..... | ..... | 3 | ..... | ..... | 12 | 15 |
| Foot rot of sheep | ..... | 15 | ..... | ..... | 10 | ..... | 166 |
| Tuberculosis: | | | | | | | |
| Condemned | 386 | 429 | 533 | 599 | 565 | 516 | 5,313 |
| Passed for food | 1,794 | 1,844 | 2,218 | 2,344 | 2,323 | 2,322 | 24,504 |

## CANADA.

The statistics of contagious diseases of animals in Canada given in the annexed table are compiled from the annual reports of the Veterinary Director General and Live Stock Commissioner for the Dominion. The conditions which existed in 1911 show no remarkable deviation from those of the two preceding years.

*Status of contagious diseases of animals in Canada annually, 1909–1911.*

| Disease. | 1909 | 1910 | 1911 |
|---|---|---|---|
| Hog cholera: | | | |
| Outbreaks | 42 | 51 | 56 |
| Hogs slaughtered | 1,881 | 1,127 | 1,346 |
| Glanders (cases) | 981 | 627 | 666 |
| Mange: | | | |
| Cattle (cases) | 15,288 | 1,944 | 3,351 |
| Horses (cases) | 497 | 333 | 402 |
| Dourine (cases) | 33 | 37 | 41 |
| Sheep scab (cases) | 226 | 122 | 69 |
| Rabies (premises quarantined) | 163 | 308 | 155 |
| Anthrax (outbreaks) | 9 | 6 | 7 |
| Hemorrhagic septicemia (cases) | ..... | ..... | 3 |

## DENMARK.

Danish farmers are not troubled very seriously with animal diseases, and the situation in 1911 was about the same as in the previous year, excepting a visitation of foot-and-mouth disease, which occurred in the latter part of 1911.

*Outbreaks of contagious diseases of animals in Denmark during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Anthrax | 21 | 20 | 25 | 22 | 19 | 10 |
| Foot-and-mouth disease | ..... | ..... | 4 | 1 | 1 | ..... |
| Foot rot of sheep | ..... | ..... | ..... | 2 | 1 | ..... |
| Spinal meningitis | ..... | 4 | 4 | 4 | 1 | 1 |
| Glanders | ..... | ..... | ..... | ..... | 1 | ..... |
| Malignant catarrhal fever | 5 | 8 | 10 | 6 | 12 | 7 |
| Hog cholera, chronic | 5 | 5 | 6 | 7 | 3 | 1 |
| Swine erysipelas, acute | 37 | 28 | 63 | 29 | 48 | 56 |

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|---|---|---|---|---|---|---|---|
| Anthrax | 7 | 14 | 19 | 22 | 26 | 25 | 230 |
| Foot-and-mouth disease | 1 | ..... | 4 | 45 | 154 | 278 | 488 |
| Foot rot of sheep | ..... | ..... | ..... | ..... | ..... | ..... | 3 |
| Spinal meningitis | ..... | 2 | 3 | 4 | 5 | 4 | 32 |
| Glanders | ..... | 1 | ..... | 1 | ..... | ..... | 3 |
| Malignant catarrhal fever | 9 | 15 | 18 | 11 | 4 | 5 | 110 |
| Hog cholera, chronic | 8 | 7 | 6 | 5 | 6 | ..... | 59 |
| Swine erysipelas, acute | 51 | 93 | 52 | 62 | 67 | 64 | 650 |

No cases were reported in 1911 of cattle plague, pleuropneumonia, sheep pox, sheep scab, or acute hog cholera.

## FRANCE.

Excepting foot-and-mouth disease, contagious diseases of animals were generally less prevalent in France during 1911 than they were the preceding year. There had been no foot-and-mouth disease reported by the French veterinary departments from May, 1909, to February, 1911, a period of 20 months. The table following, which gives the number of outbreaks of the various diseases occurring each month, shows the foot-and-mouth epizootic of 1911 to have been especially severe, as was in fact the case in all the other continental European countries.

*Status of contagious diseases of animals in France during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Pleuropneumonia (outbreaks) | 1 | | | | | |
| Foot-and-mouth disease (outbreaks) | | 145 | 222 | 216 | 462 | 3,958 |
| Sheep scab (outbreaks) | 26 | 6 | 18 | 30 | 10 | 3 |
| Sheep pox (outbreaks) | 5 | 3 | 4 | 2 | 1 | 1 |
| Anthrax (outbreaks) | 33 | 36 | 29 | 31 | 24 | 35 |
| Blackleg (outbreaks) | 56 | 66 | 71 | 56 | 66 | 65 |
| Glanders and farcy: | | | | | | |
| Outbreaks | 14 | 15 | 20 | 25 | 21 | 22 |
| Animals killed | 19 | 17 | 30 | 33 | 38 | 47 |
| Rabies (cases) | 102 | 116 | 120 | 140 | 178 | 123 |
| Erysipelas of swine (outbreaks) | 36 | 27 | 24 | 16 | 25 | 47 |
| Hog cholera (outbreaks) | 34 | 46 | 32 | 30 | 50 | 29 |

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|---|---|---|---|---|---|---|---|
| Pleuropneumonia (outbreaks) | | | | | | | 1 |
| Foot-and-mouth disease (outbreaks) | 16,027 | 33,966 | 20,729 | 14,115 | 8,527 | 5,954 | 104,321 |
| Sheep scab (outbreaks) | 10 | 3 | 5 | 1 | 9 | 7 | 128 |
| Sheep pox (outbreaks) | 6 | 5 | 15 | 21 | 14 | 12 | 89 |
| Anthrax (outbreaks) | 47 | 265 | 110 | 77 | 43 | 39 | 769 |
| Blackleg (outbreaks) | 86 | 95 | 60 | 108 | 99 | 78 | 906 |
| Glanders and farcy: | | | | | | | |
| Outbreaks | 13 | 14 | 14 | 19 | 8 | 9 | 195 |
| Animals killed | 18 | 23 | 19 | 22 | 14 | 24 | 304 |
| Rabies (cases) | 123 | 96 | 97 | 104 | 87 | 112 | 1,398 |
| Erysipelas of swine (outbreaks) | 47 | 44 | 60 | 67 | 73 | 52 | 518 |
| Hog cholera (outbreaks) | 30 | 14 | 15 | 20 | 26 | 27 | 343 |

No outbreaks of dourine were reported.

## GERMANY.

The table below has been compiled from official reports which appear biweekly concerning the status of certain contagious diseases of animals in the German Empire. The figures in the table show no marked deviation from those of the preceding year except in the case of foot-and-mouth disease, which was enormously prevalent in 1911.

*Number of farms infected with contagious diseases of animals in Germany at monthly periods during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Glanders and farcy | 32 | 31 | 29 | 28 | 31 | 33 |
| Pleuropneumonia | 1 | 1 | ..... | ..... | ..... | ..... |
| Foot-and-mouth disease | 4,882 | 5,082 | 8,513 | 10,153 | 12,505 | 13,493 |
| Hog cholera and swine plague | 1,360 | 1,227 | 1,206 | 1,031 | 1,032 | 982 |

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| Glanders and farcy | 35 | 33 | 31 | 25 | 26 | 27 |
| Foot-and-mouth disease | 20,792 | 31,926 | 38,250 | 35,250 | 33,707 | 22,676 |
| Hog cholera and swine plague | 1,012 | 987 | 976 | 1,043 | 1,210 | 1,139 |

The above table represents the only official information available on animal diseases in Germany for the year 1911, and it will be noted the data refer to number of premises infected and not to individual cases of animals. The following table, compiled from the official annual report of animal diseases in the German Empire, shows more complete data up to 1910, as it includes a greater number of diseases and also indicates the number of each species of animals involved.

*Cases of contagious diseases of animals in the German Empire annually, 1906 to 1910.*

| Name of disease. | 1906 | 1907 | 1908 | 1909 | 1910 |
|---|---|---|---|---|---|
| Anthrax: | | | | | |
| Cattle | 5,390 | 5,343 | 4,868 | 5,110 | 5,184 |
| Horses | 183 | 127 | 125 | 155 | 145 |
| Sheep | 502 | 492 | 369 | 409 | 350 |
| Goats | 14 | 14 | 13 | 14 | 15 |
| Swine | 137 | 205 | 216 | 258 | 308 |
| Blackleg: | | | | | |
| Cattle | 1,973 | 1,762 | 1,758 | 1,962 | 1,799 |
| Horses | 8 | 5 | 7 | 2 | 4 |
| Sheep | 42 | 61 | 67 | 67 | 55 |
| Swine | 2 | 1 | ..... | ..... | 2 |
| Hemorrhagic septicemia: | | | | | |
| Cattle | 20 | 22 | 21 | 6 | 13 |
| Horses | ..... | 1 | 1 | ..... | ..... |
| Swine | ..... | ..... | 1 | ..... | 7 |
| Rabies: | | | | | |
| Dogs | 610 | 700 | 585 | 769 | 451 |
| Cattle | 49 | 65 | 77 | 207 | 62 |
| Other animals | 22 | 51 | 21 | 34 | 15 |
| Suspects killed | 1,357 | 1,393 | 1,111 | 1,499 | 748 |
| Glanders: | | | | | |
| Horses infected | 398 | 442 | 418 | 310 | 290 |
| Died and killed | 536 | 532 | 526 | 371 | 322 |
| Foot-and-mouth disease: | | | | | |
| Cattle | 9,428 | 23,991 | 18,773 | 1,082 | 347,955 |
| Sheep | 8,198 | 16,875 | 19,450 | 542 | 295,059 |
| Goats | 254 | 134 | 179 | 5 | 5,905 |
| Swine | 7,550 | 13,185 | 16,081 | 178 | 297,080 |

*Cases of contagious diseases of animals in the German Empire annually, 1906 to 1910*—Continued.

| Name of disease. | 1906 | 1907 | 1908 | 1909 | 1910 |
|---|---|---|---|---|---|
| Pleuropneumonia | ..... | 583 | 1,449 | 13 | 2 |
| Sheep pox | 102 | 214 | 154 | ..... | ..... |
| Dourine of horses | ..... | ..... | 82 | 99 | ..... |
| Coital exanthema: | | | | | |
| Cattle | 6,308 | 5,653 | 4,680 | 4,963 | 5,448 |
| Horses | 306 | 193 | 206 | 382 | 335 |
| Scabies: | | | | | |
| Sheep | 53,955 | 81,257 | 102,215 | 79,669 | 52,989 |
| Horses | 655 | 690 | 959 | 756 | 918 |
| Erysipelas of swine: | | | | | |
| Swine infected | 76,723 | 75,619 | 52,689 | 61,448 | 76,357 |
| Died and killed | 56,367 | 55,720 | 35,714 | 42,293 | 48,657 |
| Hog cholera and swine plague: | | | | | |
| Swine infected | 104,728 | 92,033 | 75,688 | 65,582 | 85,632 |
| Died and killed | 77,830 | 70,991 | 60,101 | 50,579 | 66,146 |
| Influenza of horses | ..... | ..... | 3,439 | 8,384 | 8,778 |

## GREAT BRITAIN AND IRELAND.

The total for Great Britain, compiled from reports of the British Board of Agriculture and Fisheries, shows a favorable situation in regard to the majority of the scheduled diseases during 1911. There was a considerable diminution in glanders, anthrax, and sheep scab, but the two remaining diseases, foot-and-mouth disease and swine fever—the latter the same as our hog cholera—proved to be unusually troublesome.

*Annual status of contagious diseases of animals in Great Britain, 1904–1911.*

| Disease. | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 |
|---|---|---|---|---|---|---|---|---|
| Foot-and-mouth disease: | | | | | | | | |
| Outbreaks | ..... | ..... | ..... | ..... | 3 | ..... | 2 | 19 |
| Cases | ..... | ..... | ..... | ..... | 112 | ..... | 15 | 487 |
| Glanders and farcy: | | | | | | | | |
| Outbreaks | 1,529 | 1,214 | 1,070 | 850 | 785 | 536 | 351 | 208 |
| Cases | 2,658 | 2,068 | 2,012 | 1,934 | 2,421 | 1,761 | 1,014 | 501 |
| Sheep scab (outbreaks) | 1,418 | 918 | 534 | 751 | 849 | 685 | 556 | 434 |
| Anthrax: | | | | | | | | |
| Outbreaks | 1,049 | 970 | 939 | 1,089 | 1,108 | 1,316 | 1,496 | 907 |
| Cases | 1,589 | 1,317 | 1,325 | 1,466 | 1,426 | 1,700 | 1,776 | 1,120 |
| Swine fever: | | | | | | | | |
| Outbreaks | 1,196 | 817 | 1,280 | 2,336 | 2,067 | 1,651 | 1,598 | 2,466 |
| Swine slaughtered (diseased or exposed) | 5,603 | 3,876 | 7,359 | 11,275 | 14,096 | 14,316 | 15,543 | 30,434 |

There have been no outbreaks of cattle plague, pleuropneumonia, or rabies during the above period.

The reports of the veterinary branch of the Department of Agriculture and Technical Instruction for Ireland denote the usual satisfactory state of affairs concerning animal diseases in that part of the United Kingdom. The only changes worthy of remark in the figures for 1911 are an increase in swine fever and a decrease in sheep scab, these conditions being similar to those just referred to for Great Britain.

*Annual status of contagious diseases of animals in Ireland, 1904–1911.*

| Disease. | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 |
|---|---|---|---|---|---|---|---|---|
| Anthrax: | | | | | | | | |
| Outbreaks | 4 | 4 | 4 | 3 | 8 | 9 | 6 | 9 |
| Cases | 7 | 4 | 8 | 5 | 11 | 9 | 12 | 16 |
| Glanders and farcy: | | | | | | | | |
| Outbreaks | 11 | 30 | 8 | 7 | ..... | ..... | 1 | 2 |
| Cases | 34 | 107 | 16 | 12 | ..... | ..... | 2 | 3 |
| Sheep scab: | | | | | | | | |
| Outbreaks | 486 | 339 | 256 | 333 | 384 | 445 | 463 | 342 |
| Cases | 6,433 | 4,253 | 3,513 | 5,198 | 6,182 | 7,129 | 6,075 | ..... |
| Swine fever: | | | | | | | | |
| Outbreaks | 181 | 137 | 95 | 163 | 159 | 57 | 106 | 174 |
| Cases | 931 | 1,416 | 1,103 | 2,789 | 3,625 | 373 | 514 | 2,566 |
| Epizootic lymphangitis: | | | | | | | | |
| Outbreaks | 1 | 10 | 1 | ..... | ..... | ..... | ..... | ..... |
| Cases | 1 | 25 | 1 | ..... | ..... | ..... | ..... | ..... |
| Parasitic mange: | | | | | | | | |
| Outbreaks | 162 | 169 | 85 | 77 | 42 | 77 | 62 | 66 |
| Cases | 252 | 322 | 130 | 94 | 59 | 110 | 82 | ..... |

In addition to the above the following diseases are scheduled in Ireland, but no cases were reported: Cattle plague, foot-and-mouth disease, pleuropneumonia, sheep pox, and rabies.

## HUNGARY.

The reports from Hungary, which include Croatia and Slavonia, indicate about a normal condition in all the animal diseases except foot-and-mouth disease. The latter disease was highly prevalent throughout the year in all parts of the country.

*Number of premises infected with contagious diseases of animals in Hungary at monthly periods during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Anthrax | 140 | 128 | 148 | 140 | 155 | 261 |
| Rabies | 192 | 184 | 176 | 224 | 238 | 268 |
| Glanders | 40 | 37 | 39 | 48 | 66 | 76 |
| Foot-and-mouth disease | 37,486 | 32,878 | 28,744 | 21,484 | 14,158 | 22,596 |
| Sheep pox | 270 | 212 | 165 | 103 | 55 | 50 |
| Coital exanthema: | | | | | | |
| Solipeds | 2 | 2 | 12 | 122 | 149 | 91 |
| Cattle | 18 | 13 | 16 | 22 | 27 | 43 |
| Scabies: | | | | | | |
| Solipeds | 60 | 66 | 74 | 258 | 380 | 352 |
| Sheep | 37 | 101 | 204 | 291 | 321 | 286 |
| Barbone of buffalo | 1 | 2 | ..... | 1 | 2 | 4 |
| Erysipelas of swine | 200 | 129 | 102 | 120 | 149 | 574 |
| Hog cholera | 2,411 | 1,844 | 1,497 | 1,014 | 845 | 1,626 |

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| Anthrax | 303 | 444 | 389 | 255 | 172 | 157 |
| Rabies | 262 | 297 | 248 | 215 | 217 | 207 |
| Glanders | 79 | 73 | 63 | 52 | 37 | 31 |
| Foot-and-mouth disease | 45,544 | 63,432 | 58,939 | 40,608 | 16,707 | 12,337 |
| Sheep pox | 60 | 71 | 145 | 125 | 167 | 168 |
| Coital exanthema: | | | | | | |
| Solipeds | 68 | 42 | 15 | 7 | 6 | ..... |
| Cattle | 58 | 48 | 21 | 22 | 7 | 4 |
| Scabies: | | | | | | |
| Solipeds | 254 | 195 | 104 | 62 | 49 | 34 |
| Sheep | 248 | 163 | 71 | 43 | 92 | 155 |
| Barbone of buffalo | ..... | 10 | 18 | 22 | 40 | 44 |
| Erysipelas of swine | 1,017 | 1,052 | 758 | 685 | 440 | 443 |
| Hog cholera | 2,129 | 3,891 | 3,835 | 3,329 | 3,136 | 2,686 |

The reports declare that no cattle plague or pleuropneumonia exists, and there were no outbreaks of dourine in 1911.

## INDIA.

The following table is compiled from the reports of the civil veterinary departments in British India showing the losses during the year from contagious diseases of animals. Compared with the preceding year there is indicated an increase in cattle plague, hemorrhagic septicemia, and blackleg, and a decrease in foot-and-mouth disease and surra.

*Number of deaths from contagious diseases of animals in stated Provinces of British India during the fiscal year 1911.*

| Disease. | United Provinces. | Punjab. | Bengal. | Eastern Bengal and Assam. | Total. |
|---|---|---|---|---|---|
| Cattle plague: | | | | | |
| Bovines | 15,675 | 49,154 | 11,687 | 19,137 | 95,653 |
| Others | 181 | 1,124 | ..... | 963 | 2,268 |
| Foot-and-mouth disease: | | | | | |
| Bovines | 4,734 | 1,128 | 1,846 | 6,252 | 13,960 |
| Others | 103 | 249 | ..... | 75 | 427 |
| Anthrax: | | | | | |
| Equines | 2 | 2 | 5 | 27 | 36 |
| Bovines | 1,360 | 19 | 470 | 2,342 | 4,191 |
| Others | 23 | ..... | ..... | 33 | 56 |
| Hemorrhagic septicemia: | | | | | |
| Bovines | 6,303 | 17,432 | 6,000 | 6,095 | 35,830 |
| Others | 117 | 189 | ..... | 671 | 977 |
| Glanders | 15 | 25 | 130 | 49 | 219 |
| Surra | 76 | 171 | 2 | 26 | 275 |
| Blackleg | 2,030 | 2,116 | 1,517 | 109 | 5,772 |
| Rabies | ..... | ..... | ..... | 224 | 224 |
| Tetanus | 27 | ..... | ..... | ..... | 27 |
| Pleuropneumonia | 1,204 | ..... | ..... | ..... | 1,204 |
| Other contagious diseases | 174 | 3,087 | 3,822 | 8,106 | 15,189 |

No cases of dourine were reported in any of the provinces.

## ITALY.

The animal-disease situation in Italy during 1911 was remarkable chiefly for the severe visitation of foot-and-mouth disease. This disease was prevalent throughout the previous year, but was under good control, there being less than 1,000 cases during the majority of the months. The table shows that in 1911 the cases increased rapidly each month until in July there were upward of 150,000. It is satisfactory to note that an equally rapid decline occurred after this. Swine disease was considerably less prevalent in 1911 than in 1910.

*Cases of diseases of animals in Italy at monthly periods in 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Anthrax | 37 | 17 | 55 | 22 | 21 | 40 |
| Blackleg | 2 | 3 | 5 | 1 | 2 | ..... |
| Foot-and-mouth disease | 5,427 | 25,394 | 43,811 | 44,943 | 50,281 | 62,847 |
| Sheep pox | 13 | 146 | 20 | 83 | 66 | ..... |
| Infectious disease of swine | 1,557 | 1,056 | 906 | 503 | 707 | 865 |
| Scab: | | | | | | |
| Sheep | 1,355 | 2,540 | 4,634 | 6,932 | 8,676 | 12,254 |
| Horses | 7 | 9 | 10 | ..... | ..... | ..... |
| Goats | ..... | 157 | 12 | ..... | ..... | 33 |
| Glanders and farcy | 5 | 8 | 21 | 9 | 6 | 7 |
| Rabies | 15 | 18 | 10 | 18 | 3 | 8 |
| Contagious mammitis of sheep and goats | 223 | 220 | 345 | 4,087 | 7,062 | 1,777 |

*Cases of diseases of animals in Italy at monthly periods in 1911*—Continued.

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| Anthrax | 94 | 12 | 19 | 19 | 17 | 14 |
| Blackleg | 5 | 1 | ..... | 1 | 13 | ..... |
| Foot-and-mouth disease | 157,723 | 110,400 | 44,471 | 6,649 | 18,332 | 17,852 |
| Sheep pox | 5 | ..... | ..... | ..... | ..... | ..... |
| Infectious diseases of swine | 515 | 600 | 733 | 1,011 | 805 | 636 |
| Scab: | | | | | | |
| Sheep | 7,607 | 3,780 | 322 | 671 | 1,555 | 3,520 |
| Horses | ..... | ..... | ..... | ..... | ..... | ..... |
| Goats | ..... | 14 | ..... | ..... | ..... | ..... |
| Glanders and farcy | 8 | 4 | 8 | 8 | 7 | 11 |
| Rabies | 2 | 5 | 28 | 18 | 16 | 17 |
| Contagious mammitis of sheep and goats | 4,646 | 4,643 | 3,914 | 6,236 | 248 | 232 |

## THE NETHERLANDS.

The totals in the table below show a remarkable decrease in the sheep diseases—sheep scab and foot rot—compared with 1910. There was, on the other hand, a slight increase in anthrax in 1911. The rapid development of foot-and-mouth disease during the four summer months is sharply defined.

*Status of contagious diseases of animals in The Netherlands during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Anthrax (cases) | ..... | 86 | 88 | 86 | 55 | 34 |
| Rabies (cases) | ..... | ..... | ..... | ..... | ..... | ..... |
| Mange: | | | | | | |
| Horses (cases) | ..... | ..... | ..... | ..... | ..... | 4 |
| Sheep (cases) | ..... | 39 | 107 | 5 | 44 | 9 |
| Erysipelas of swine (cases) | ..... | 8 | 14 | 14 | 21 | 50 |
| Foot rot (cases) | ..... | 25 | 49 | 111 | 43 | 22 |
| Glanders (cases) | ..... | ..... | ..... | 1 | ..... | ..... |
| Foot-and-mouth disease (outbreaks) | ..... | 44 | 138 | 328 | 4,602 | 18,214 |

| Disease. | July. | Aug. | Sep . | Oct. | Nov. | Dec. | Total. |
|---|---|---|---|---|---|---|---|
| Anthrax (cases) | 47 | 73 | 109 | 63 | 80 | 118 | ..... |
| Rabies (cases) | ..... | ..... | ..... | ..... | ..... | 1 | ..... |
| Mange: | | | | | | | |
| Horses (cases) | 2 | ..... | 1 | ..... | ..... | ..... | ..... |
| Sheep (cases) | 100 | 6 | 64 | 61 | 15 | 48 | ..... |
| Erysipelas of swine (cases) | 109 | 399 | 193 | 90 | 28 | 33 | ..... |
| Foot rot (cases) | 5 | 20 | 1 | 1 | ..... | 23 | ..... |
| Glanders | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Foot-and-mouth disease (outbreaks) | 12,358 | 15,503 | 13,477 | 4,391 | 1,089 | 302 | ..... |

There were no cases reported of trichinosis of swine.

## NORWAY.

The Norwegian reports of animal diseases for 1911 differ but slightly from those of the preceding year. It may be noted, however, that there was but one outbreak of swine disease in 1911, involving 16 animals.

*Cases of contagious diseases of animals in Norway during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Anthrax | 29 | 37 | 39 | 34 | 48 | 21 |
| Blackleg | 1 | 2 | 5 | 3 | 7 | 11 |
| Braxy of sheep | 6 | 8 | 6 | 13 | 15 | 4 |
| Malignant catarrhal fever | 26 | 49 | 59 | 50 | 55 | 44 |
| Hog cholera and swine plague | ..... | ..... | ..... | ..... | 16 | ..... |

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|---|---|---|---|---|---|---|---|
| Anthrax | 20 | 36 | 40 | 22 | 26 | 22 | 374 |
| Blackleg | 4 | 6 | 12 | 8 | 4 | 6 | 69 |
| Braxy of sheep | ..... | ..... | 4 | 19 | 15 | 24 | 114 |
| Malignant catarrhal fever | 42 | 40 | 44 | 36 | 29 | 31 | 505 |
| Hog cholera and swine plague | ..... | ..... | ..... | ..... | ..... | ..... | 16 |

No cases were reported of cattle plague, pleuropneumonia, foot-and-mouth disease, rabies, glanders, sheep pox, sheep scab, or foot rot of sheep.

## SWEDEN.

Anthrax, the only animal disease that gives much trouble in Sweden, was rather more prevalent in 1911 than in the preceding year, for which the total outbreaks numbered 355. Foot-and-mouth disease made its appearance in October, there having been no previous outbreak since February, 1910. It seems to have been promptly suppressed, however, as no new cases were reported in December.

*Outbreaks of contagious diseases of animals in Sweden during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Anthrax | 33 | 43 | 46 | 47 | 52 | 40 |
| Blackleg | 1 | 2 | 1 | 2 | 4 | 11 |
| Foot-and-mouth disease | ..... | ..... | ..... | ..... | ..... | ..... |
| Swine plague | 1 | 1 | 1 | 2 | ..... | 1 |
| Swine erysipelas, acute | ..... | ..... | ..... | 1 | ..... | ..... |

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|---|---|---|---|---|---|---|---|
| Anthrax | 34 | 27 | 19 | 31 | 27 | 26 | 424 |
| Blackleg | 9 | 14 | 7 | 10 | 8 | 3 | 72 |
| Foot-and-mouth disease | ..... | ..... | ..... | 3 | 2 | ..... | 5 |
| Swine plague | 1 | 3 | 1 | 1 | 2 | ..... | 14 |
| Swine erysipelas, acute | ..... | 1 | ..... | ..... | ..... | ..... | 2 |

No cases were reported of cattle plague, pleuropneumonia, glanders, sheep pox, sheep scab, foot rot, rabies, or hog cholera.

## SWITZERLAND.

Switzerland shared the fate of its neighbors in having to deal with a great increase in foot-and-mouth disease. It will be noticed by a reference to the table that the contagion was particularly rampant during the summer months. On the other hand the swine diseases were much less prevalent than they were in 1910. There were no cases of rabies in 1910, but six were reported during 1911.

*Cases of contagious diseases of animals in Switzerland during 1911.*

| Disease. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|
| Anthrax | 16 | 4 | 12 | 18 | 40 | 57 |
| Blackleg | 38 | 15 | 19 | 24 | 27 | 14 |
| Foot-and-mouth disease: | | | | | | |
| Cattle | 413 | 451 | 505 | 317 | 237 | 222 |
| Other animals | 346 | 562 | 264 | 112 | 54 | 85 |
| Rabies | ..... | ..... | ..... | ..... | 3 | 1 |
| Glanders and farcy | ..... | 4 | 1 | 2 | 11 | ..... |
| Swine erysipelas and cholera | 702 | 666 | 792 | 730 | 847 | 865 |
| Sheep scab | ..... | ..... | ..... | ..... | 5 | ..... |

| Disease. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|---|---|---|---|---|---|---|---|
| Anthrax | 191 | 169 | 110 | 53 | 40 | 31 | 741 |
| Blackleg | 23 | 27 | 21 | 28 | 27 | 32 | 295 |
| Foot-and-mouth disease: | | | | | | | |
| Cattle | 13,193 | 7,696 | 3,740 | 751 | 870 | 1,421 | 29,816 |
| Other animals | 7,352 | 6,699 | 1,347 | 1,144 | 310 | 397 | 18,672 |
| Rabies | 1 | 1 | ..... | ..... | ..... | ..... | 6 |
| Glanders and farcy | ..... | 3 | ..... | 1 | 3 | ..... | 25 |
| Swine erysipelas and cholera | 1,531 | 703 | 606 | 731 | 611 | 453 | 9,237 |
| Sheep scab | ..... | ..... | ..... | 5 | ..... | 4 | 14 |

There were no cases of pleuropneumonia.

# APPENDIX.

## ORGANIZATION AND WORK OF THE BUREAU OF ANIMAL INDUSTRY.[1]

A. D. MELVIN, *Chief of Bureau.*
A. M. FARRINGTON, *Assistant Chief.*
CHARLES C. CARROLL, *Chief Clerk.*

The Bureau of Animal Industry has charge of the work of the department relating to the live-stock industry. In general it deals with the investigation, control, and eradication of diseases of animals, the inspection and quarantine of live stock, the inspection of meat and meat-food products, and with animal husbandry and dairying.

The bureau conducts the inspection of live stock, meats, and meat-food products intended for interstate or foreign commerce, under the act of Congress of June 30, 1906, and also has charge of the inspection of import and export animals, the inspection of ships for the transportation of export animals, and the quarantine stations for imported animals. It investigates the existence of communicable diseases of live stock, makes original scientific investigations as to the nature, cause, and prevention of such diseases, and takes measures for their repression and eradication, frequently in cooperation with State and Territorial authorities. As part of this work a quarantine of the section infected with Texas or southern fever of cattle is maintained, the extermination of the tick which transmits this disease has been undertaken, and sheep scab and cattle mange are being eradicated from the West. The bureau makes investigations in the breeding and feeding of animals and in regard to dairy subjects, and supervises the manufacture of and interstate commerce in renovated butter. Reports of scientific investigations and treatises on various subjects relating to the live-stock industry are prepared and published.

A synopsis of the work of each division follows.

### THE ANIMAL HUSBANDRY DIVISION.

GEORGE M. ROMMEL, *Chief.*

This division gathers information and makes studies and experiments concerning the breeding and feeding of farm animals and poultry; determines the pure breeding of animals imported into the United States for breeding purposes under paragraph 492 of the tariff act of August 5, 1909, and attends to correspondence and prepares publications on these subjects. The division is now engaged in experiments in breeding small animals; the study of crossbreeding in sheep; the utilization of native goats for milk production; hybridizing the Grévy zebra with asses and horses; a study of the cost of production of poultry and eggs; a study of methods to improve the quality of farm eggs; and a study of market and transportation problems connected with the egg and poultry

[1] Revised to July 1, 1912.

trade. Cooperative work with State agricultural experiment stations comprises investigations in animal nutrition at the Pennsylvania station, in beef production at the Alabama station, in horse breeding in Colorado, Iowa, and Vermont, in breeding milking Shorthorn cattle in Minnesota, in breeding Holstein-Friesian cattle in North Dakota, in poultry breeding and management in Maine, and in sheep breeding in Wyoming. The staff of this division includes G. Arthur Bell, senior animal husbandman in certification of pedigrees; E. L. Shaw, senior animal husbandman in sheep and goat investigations; Harry M. Lamon, junior animal husbandman in poultry investigations; E. H. Riley, animal husbandman in animal-breeding investigations; W. F. Hammond, superintendent of Morgan horse farm; John O. Williams, junior animal husbandman, in charge of Colorado horse-breeding station; Ralph J. Carr, junior animal husbandman in animal-nutrition investigations; and H. H. Reese, in charge of work of this division at the experiment farm, Beltsville, Md.

## THE BIOCHEMIC DIVISION.

M. DORSET, *Chief.*

This division prepares tuberculin and mallein and furnishes these substances free of charge to health officers for use in official tests. It conducts experiments concerning immunity, with the object of obtaining vaccines and antitoxins for animal diseases; carries on researches concerning the causes of certain infectious diseases; in connection with the meat-inspection service makes bacteriological and chemical examination of meats and meat-food products and of condiments, etc., used in their preparation; carries on experiments with dips and disinfectants; assists in enforcing the insecticide act of 1910 by examining articles intended for use in combating insects and fungi which infest domestic animals; prepares records of tests and experiments; and prepares for publication from time to time reports of work which has been completed.

The scientific staff of the division includes J. A. Emery, in charge of research work on meat products; T. M. Price, in charge of central meat-inspection laboratory; C. N. McBryde, in charge of bacteriological investigations of meats; W. B. Niles, inspector in charge of field experiments concerning hog cholera; R. M. Chapin, in charge of investigations of stock dips; A. E. Graham, C. H. Swanger, A. H. Roop, W. B. Smith, E. A. Boyer, and C. T. Marsh, chief laboratory inspectors in branch meat-inspection laboratories.

## THE DAIRY DIVISION.

B. H. RAWL, *Chief.*

The work of this division is "to collect and disseminate information concerning dairy farming, the care and improvement of dairy cattle, and the production, care, and distribution of dairy products." It maintains a general survey of the condition of the dairy industry in the country at large and in the different sections, in addition to special inquiries as to dairy organizations, dairy schools and facilities for technical instruction, State dairy laws, the development of markets, the milk supply of cities and towns, and the laws and regulations in reference thereto.

Investigations are conducted in dairy-farm management, including special work in the Southern and Western States for the introduction of better dairy practice and the encouragement of diversified farming through the introduction of dairying. The formation of cow-test associations on a self-sustaining basis is receiving attention.

The division also makes investigations as to the manufacture of butter and cheese, including European varieties of cheese, and concerning dairy machinery and equipment. The division architect prepares plans and technical advice for the construction of sanitary and economical dairy buildings. The organization and management of creameries and factories and of the larger dairy enterprises, now increasing in number and importance, are receiving special attention. The division is also charged with the details of administration of the laws concerning the inspection of factories and markets for "renovated" or "process" butter.

Considerable attention has been given to work in connection with the improvement of city milk supplies. This is accomplished by means of cooperation with the local authorities. Public meetings are arranged wherein the producers, consumers, physicians, and others are brought together and the subject of milk improvement discussed. There is usually also a competitive exhibit of milk and cream. The score-card system of scoring dairies and farms used and recommended by the division is indispensable for this work. It has been found of great value in a large number of cities where it is now regularly in use.

Reports upon these lines of work are prepared and published, and an extensive correspondence is conducted to ascertain and meet the needs of those interested in the various departments of the dairy industry. The division seeks to serve as a clearing house for dairy experience and information. Its officers and agents visit the dairy centers and conventions for personal contact and advice.

The work of the Dairy Division is subdivided as follows: Dairy farming investigations, in charge of Helmer Rabild; dairy products investigations, in charge of L. A. Rogers; dairy manufacturing investigations, in charge of S. C. Thompson; market milk investigations, in charge of Ernest Kelly; renovated butter inspection, in charge of Robert McAdam.

## THE MEAT INSPECTION DIVISION.

R. P. STEDDOM, *Chief.*

The work of the Meat Inspection Division includes the ante-mortem and the post-mortem inspection of cattle, sheep, swine, and goats, slaughtered at establishments engaged in interstate or foreign commerce; the supervision of such establishments and of the various processes of preparing, curing, canning, packing, etc., so as to insure sanitary conditions, equipment, and methods; the condemnation and proper disposal of carcasses and products found to be diseased, unwholesome, or otherwise unfit for human food; the marking and certification of meats and products that have been inspected and passed, and the regulation and supervision of the interstate transportation and exportation of meats and meat food products. The meat inspection is now carried on at 852 establishments in 242 cities and towns.

## THE FIELD INSPECTION DIVISION.

R. A. RAMSAY, *Chief.*

The work of this division consists in the inspection of live stock at points of origin, in transit, and at market centers, the disinfecton of cars, and the supervision and enforcement of other measures to prevent the spread of contagious diseases through the channels of interstate commerce and to stamp out such diseases. This includes the eradication of southern cattle ticks, the inspection of southern cattle, and the supervision of their movement when forwarded from the area quarantined on account of Texas or southern cattle fever, also the inspec-

tion and, when necessary, the dipping of sheep and cattle to eradicate and prevent the spread of scabies. As a result of the latter work, in cooperation with State and Territorial authorities, sheep scab and cattle mange have been wiped out from large areas in the West where they were formerly prevalent, and efforts are being directed toward the ultimate eradication of these diseases from the United States.

## THE PATHOLOGICAL DIVISION.

JOHN R. MOHLER, *Chief.*

The work of this division is chiefly along the lines of investigating diseases of animals. It prepares and distributes blackleg vaccine and tabulates the results for publication; conducts scientific investigations of animal diseases; carries on experiments with immunizing agents for the purpose of protecting animals against diseases; cooperates with the State agricultural experiment stations with a view to combating diseases peculiar to the localities; determines pathological specimens referred to the division for diagnosis; and prepares answers to numerous inquiries regarding diseases of animals. Reports are prepared and published upon the experimental work carried on.

The scientific staff of the division includes Henry J. Washburn, senior bacteriologist; J. S. Buckley, in charge of blackleg investigations; George Byron Morse, in charge of investigations concerning diseases of poultry and cold-blooded animals; Charles F. Flocken, in charge of cooperative experiments with the Minnesota Experiment Station; Adolph Eichhorn, in charge of field investigations; Robert J. Formad, assistant in animal pathology; Jacob Traum, assistant in animal bacteriology; H. C. Campbell, in charge of cooperative experiments with Pennsylvania Live-stock Sanitary Board; H. J. Frederick, in charge of cooperative experiments with Utah Experiment Station; and L. Enos Day, in charge of branch pathological laboratory at Chicago, Ill.

## THE QUARANTINE DIVISION.

RICHARD W. HICKMAN, *Chief.*

The inspection and quarantine of imported animals with a view to excluding contagion, the management of the animal quarantine stations, and the inspection of live stock for export come under this division. The ships carrying exported animals are also inspected, and regulations as to fittings, equipment, ventilation, feed, water, attendants, etc., are enforced. The Quarantine Division administers the sanitary regulations governing the importation of hides, hay, and straw, and directs the tuberculin testing of cattle and the mallein testing of horses for export and import. It also carries on cooperative work with State and other authorities for the intrastate tuberculin testing of dairy and breeding cattle and of cows supplying milk to cities, with a view to eliminating tuberculosis from dairy herds and from among such breeding cattle.

George W. Pope is acting assistant chief, and B. T. Woodward is in charge of the tuberculin testing of dairy cattle.

## THE ZOOLOGICAL DIVISION.

B. H. RANSOM, *Chief.*

This division investigates diseases of parasitic origin, and prepares and publishes reports on such investigations; collects and describes animal parasites of all kinds; determines such parasites as are sent to the bureau for identification, and conducts correspondence regarding them; keeps a card index of animal

parasites and a bibliography of literature relating to them. Assistant zoologists are Albert Hassall, H. W. Graybill, Maurice C. Hall, and Howard Crawley; junior zoologist, W. D. Foster.

### THE EXPERIMENT STATION.

E. C. SCHROEDER, *Superintendent;* W. E. COTTON, *Assistant.*

The Experiment Station of the bureau is located at Bethesda, Md. It is equipped for and conducts investigations regarding animal diseases with a view to their control and eradication and their bearing on the public health. A small farm is maintained in such a manner as to provide the other divisions of the bureau with facilities for making observations for which large domestic animals are needed.

The work of the station consists of independent original investigations and investigations in cooperation with and supplemental to those of the other divisions. Reports of the results obtained are written for publication.

### THE EDITORIAL OFFICE.

JAMES M. PICKENS, *Editor.*

The work of this office comprises the editing and proof reading of the publications of the bureau, the indexing of such as require it, the compilation of the annual report, and the preparation of special articles and other material for publication. This office also makes translations, compiles information, and attends to correspondence relating to the bureau's publications and miscellaneous subjects.

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## PUBLICATIONS OF THE BUREAU IN 1911.

Following is a list of publications issued by the Bureau of Animal Industry during the year 1911, excepting regulations, which are to be found in this report (pp. 309–343). A circular giving a list of the available publications of the bureau will be sent free upon request addressed to the Secretary of Agriculture. The editions of some of the publications are necessarily limited, and when the supply is exhausted and no funds are available for procuring additional copies applicants will be referred to the Superintendent of Documents, Government Printing Office, Washington, D. C., the officer designated by law to sell Government publications.

#### REPORTS.

Twenty-sixth Annual Report of the Bureau of Animal Industry for the year 1909. Pp. 407, pls. 5, figs. 10.

Report of the Chief of the Bureau of Animal Industry for [the fiscal year ended June 30] 1911. Pp. 66.

Special Report on Diseases of the Horse. By Drs. Pearson, Michener, Law, Harbaugh, Trumbower, Liautard, Holcombe, Huidekoper, Stiles, Mohler, and Adams. Pp. 614, pls. 42, figs. 18. (Revised edition, 1911.)

#### BULLETINS.

Bulletin 39, Part 33. Index-Catalogue of Medical and Veterinary Zoology. By Ch. Wardell Stiles, consulting zoologist, Bureau of Animal Industry; professor of zoology, United States Public Health and Marine-Hospital Service; and Albert Hassall, assistant zoologist, Bureau of Animal Industry. Authors: W to Werbitzki. Pp. 2509–2582.

*Same,* Part 34. Authors: Werlhof to Xémard. Pp. 2583–2654.

*Same,* Part 35. Authors: Y to Zypkin. Pp. 2655–2703.

Bulletin 110, Part II. A Biometrical Study of Egg Production in the Domestic Fowl. II. Seasonal Distribution of Egg Production. By Raymond Pearl, expert in poultry breeding, Bureau of Animal Industry, and biologist, Maine Agricultural Experiment Station; and Frank M. Surface, associate biologist, Maine Agricultural Experiment Station. Pp. i–viii, 81–170, figs. 30.

Bulletin 127. The Nematodes Parasitic in the Alimentary Tract of Cattle, Sheep, and Other Ruminants. By B. H. Ransom, chief of the Zoological Division. Pp. 132, figs. 152.

Bulletin 128. The Influence of Type and of Age upon the Utilization of Feed by Cattle. Investigations in cooperation with the Institute of Animal Nutrition of the Pennsylvania State College. By Henry Prentiss Armsby and J. August Fries. Pp. 245, pls. 3, figs. 17.

Bulletin 129. Cattle Breeders' Associations in Denmark. By Frederik Rasmussen, professor of dairying, New Hampshire College of Agriculture and Mechanic Arts. Pp. 40, pls. 2.

Bulletin 130. Studies on the Biology of the Texas-Fever Tick. By H. W. Graybill, assistant zoologist, Zoological Division, Bureau of Animal Industry. Pp. 42, figs. 3.

Bulletin 131. Beef Production in Alabama. I. Cost of Raising the Cattle. II. Wintering Steers Preparatory to Summer Fattening on Pasture. III. Fattening Cattle on Pasture. By Dan T. Gray, professor of animal husbandry, Alabama Polytechnic Institute, and W. F. Ward, junior animal husbandman, Bureau of Animal Industry. Pp. 47, pls. 2.

Bulletin 132. A Bacteriological Study of Ham Souring. By C. N. McBryde, senior bacteriologist, Biochemic Division. Pp. 55, pls. 4, figs. 5.

Bulletin 133. The Determination of Nicotin in Nicotin Solutions and Tobacco Extracts. By Robert M. Chapin, senior biochemist, Biochemic Division. Pp. 22.

Bulletin 134. The Estimation of Total Solids in Milk by the Use of Formulas. By R. H. Shaw, dairy chemist, Dairy Division, and C. H. Eckles, professor of dairy husbandry, University of Missouri. Pp. 31, fig. 1.

Bulletin 135. A Comparative Study of Methods of Examining Feces for Evidences of Parasitism. By Maurice C. Hall, assistant zoologist, Zoological Division. Pp. 36, fig. 1.

Bulletin 136. The Diagnosis of Glanders by Complement Fixation. By John R. Mohler, chief of the Pathological Division, and Adolph Eichhorn, bacteriologist, Pathological Division. Pp. 31, pls. 5.

*Same*, revised. Pp. 32, pls. 5.

Bulletin 137. Anthrax, With Special Reference to the Production of Immunity. By Charles F. Dawson, veterinarian, Delaware College Agricultural Experiment Station, under the direction of John R. Mohler, chief of the Pathological Division, Bureau of Animal Industry. Pp. 47.

Bulletin 138. The Milk Supply of Chicago and Washington. By George M. Whitaker, in charge of market milk investigations, Dairy Division. Pp. 40, pls. 8, figs. 6.

Bulletin 139. The Nutritive Value of the Nonprotein of Feeding Stuffs. By Henry Prentiss Armsby, director of the Institute of Animal Nutrition of the Pennsylvania State College; expert in animal nutrition, Bureau of Animal Industry. Pp. 49.

Bulletin 140. Fattening Poultry. By Alfred R. Lee, junior animal husbandman, Animal Husbandry Division. Pp. 60, pls. 4, figs. 2.

Bulletin 141. The Improvement of the Farm Egg. By Harry M. Lamon and Charles L. Opperman, junior animal husbandmen, Animal Husbandry Division. Pp. 43, pls. 4, figs. 2.

Bulletin 142. Dourine of Horses: Its Cause and Suppression. By John R. Mohler, chief of the Pathological Division. Pp. 38, pls. 5.

Bulletin 146. Varieties of Cheese: Description and Analyses. By C. F. Doane, assistant dairyman, Dairy Division, and H. W. Lawson, Office of Experiment Stations, Department of Agriculture. (A revision of Bulletin 105.) Pp. 78.

CIRCULARS.

Circular 31 (third revision). Blackleg: Its Nature, Cause, and Prevention. By Victor A. Nörgaard; revised by John R. Mohler. Pp. 23, fig. 1.

Circular 150–A. List of Accredited Veterinary Colleges. Pp. 2.

Circular 166. The Digestibility of Cheese. By C. F. Doane, assistant dairyman, Dairy Division, in cooperation with the Office of Experiment Stations. Pp. 22.

Circular 167. The Dimethyl Sulphate Test of Creosote Oils and Creosote Dips; a Substitute for the Sulphonation Test. By Robert M. Chapin, senior biochemist, Biochemic Division. Pp. 6.

Circular 168. A Note on the Feeding Value of Coconut and Peanut Meals for Horses. By George M. Rommel, chief of the Animal Husbandry Division, and W. F. Hammond, superintendent Morgan Horse Farm. Pp. 2.

Circular 169. A Study of Surra Found in an Importation of Cattle, Followed by Prompt Eradication. By John R. Mohler, Chief of the Pathological Division, and William Thompson, veterinary inspector, Bureau of Animal Industry. Pp. i–iv, 81–97, pls. 3, figs. 2. (Reprinted from the Twenty-sixth Annual Report of the Bureau of Animal Industry.)

Circular 170. The Extra Cost of Producing Clean Milk. By George M. Whitaker, in charge of market milk investigations, Dairy Division. Pp. i–ii, 119–131, pls. 4, fig. 1. (Reprinted from Twenty-sixth Annual Report of the Bureau of Animal Industry.)

Circular 171. Fermented Milks. By L. A. Rogers, bacteriologist in charge of research laboratories, Dairy Division. Pp. i–ii, 133–161, fig. 1. (Reprinted from Twenty-sixth Annual Report of the Bureau of Animal Industry.)

Circular 172. The Ostrich Industry of the United States. By A. R. Lee, junior animal husbandman, Animal Husbandry Division. Pp. i–ii, 233–238, pls. 3. (Reprinted from Twenty-sixth Annual Report of the Bureau of Animal Industry.)

Circular 173. The Sanitary Construction and Equipment of Abattoirs and Packing Houses. By G. H. Parks, architect, Bureau of Animal Industry. Pp. i–iv, 247–263, pl. 1, fig. 1. (Reprinted from Twenty-sixth Annual Report of the Bureau of Animal Industry.)

Circular 174. Eradicating Cattle Ticks in California. By William M. MacKellar, veterinary inspector in charge, and George H. Hart, assistant in pathology and bacteriology. Pp. i–iv, 283–300, pl. 1, figs. 4. (Reprinted from Twenty-sixth Annual Report of the Bureau of Animal Industry.)

Circular 175. The Control of Bovine Tuberculosis. Report of the International Commission of the American Veterinary Medical Association, September, 1910. Pp. 27.

Circular 176. A System of Poultry Accounting. By Rob R. Slocum, animal husbandman in poultry investigations, Animal Husbandry Division. Pp. 6.

Circular 177. Information for Inspectors of Animals for Breeding Purposes. Pp. 3.

Circular 178. Breeding Horses for the United States Army. Pp. 13. (Reprinted from the Report of the Chief of the Bureau of Animal Industry for 1910.)

Circular 179. Cow-Testing Associations. By Helmer Rabild, in charge of dairy farming investigations, Dairy Division. Pp. 24.

Circular 180. A Method for the Separation of the Seven Permitted Coal-Tar Colors When Occurring in Mixtures. By T. M. Price, senior biochemist, Biochemic Division. Pp. 7.

Circular 181. Methods and Results of Paraffining Cheese. By C. F. Doane, assistant dairyman, Dairy Division. Pp. 16.

Circular 182. The Spontaneous Oxidation of Arsenical Dipping Fluids. By Aubrey V. Fuller, assistant chemist, Biochemic Division. Pp. 8.

Circular 183. Directions for Constructing a Vat and Dipping Cattle to Destroy Ticks. By H. W. Graybill, assistant zoologist, Zoological Division, and W. P. Ellenberger, veterinary inspector, Inspection Division. Pp. 15, fig. 1.

Circular 186. The Army Remount Problem. By George M. Rommel, chief of the Animal Husbandry Division. Pp. i–ii, 103–124, pls. 5.

FARMERS' BULLETINS.

Farmers' Bulletin 439. Anthrax, with Special Reference to Its Suppression. By Henry J. Washburn, senior pathologist, Pathological Division. Pp. 16.

Farmers' Bulletin 445. Marketing Eggs Through the Creamery. By Bob R. Slocum, animal husbandman in poultry investigations, Animal Husbandry Division. Pp. 12.

Farmers' Bulletin 449. Rabies or Hydrophobia. By John R. Mohler, chief of the Pathological Division. Pp. 23.

Farmers' Bulletin 452. Capons and Caponizing. By Rob R. Slocum, animal husbandman in poultry investigations, Animal Husbandry Division. Pp. 16, figs. 7.

Farmers' Bulletin 473. Tuberculosis. A Plain Statement of Facts Regarding the Disease. Prepared Especially for Farmers and Others Interested in Live Stock. By the International Commission of the American Veterinary Medical Association on the Control of Bovine Tuberculosis. Pp. 23, figs. 13.

Farmers' Bulletin 478. How to Prevent Typhoid Fever. By Logan Waller Page, John R. Mohler, and Erwin F. Smith. Pp. 8.

SEPARATES FROM TWENTY-SIXTH ANNUAL REPORT.

A Note on Zebra Hybrid Breeding. By E. H. Riley, animal husbandman in animal-breeding investigations, Animal Husbandry Division. Pp. i–ii, 229–232, pls. 3.

The Use of Metallic Containers for Edible Fats and Oils. By James A. Emery, senior biochemist, Biochemic Division. Pp. i–iv, 265–282.

The Viability of Tubercle Bacilli in Butter. By John R. Mohler, Henry J. Washburn, and Lore A. Rogers. The Viability of Tubercle Bacilli in Cheese. By John R. Mohler, Henry J. Washburn, and C. F. Doane. Pp. i–ii, 179–191.

Medical Milk Commissions and Bovine Tuberculosis. By E. C. Schroeder, superintendent of the Bureau Experiment Station. Pp. i–iv, 193–200.

SEPARATES FROM DEPARTMENT YEARBOOK.

The Grading of Cream. By B. D. White, in charge of dairy manufacturing investigations, Dairy Division. Pp. i–ii, 275–280.

The Eradication of Cattle Tuberculosis in the District of Columbia. By R. W. Hickman, chief of the Quarantine Division. Pp. i–iv, 231–242.

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Animals Imported for Breeding Purposes for Which Certificates of Pure Breeding have been Issued by the Bureau of Animal Industry. Horses, January 1 to March 31, 1911. Pp. 16.
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State Sanitary Requirements Governing Admission of Live Stock. Pp. 23.
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# RULES AND REGULATIONS OF THE SECRETARY OF AGRICULTURE RELATING TO THE ANIMAL INDUSTRY ISSUED IN 1911.

AMENDMENT 5 TO B. A. I. ORDER 143.

## Amendment 5 to B. A. I. Order 143 (Regulations of the Secretary of Agriculture Governing the Inspection, Disinfection, Certification, Treatment, Handling, and Method and Manner of Delivery and Shipment of Live Stock which is the Subject of Interstate Commerce). Amending Paragraph (a) of Regulation 33 Relating to the Use of Tobacco or Tobacco Products Containing Nicotine Permitted in the Official Dipping of Sheep for Scabies (Effective on and after May 1, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

It is ordered that Paragraph (*a*) of Regulation 33 of the regulations of the Secretary of Agriculture governing the inspection, disinfection, certification, treatment, handling, and method and manner of delivery and shipment of live stock which is the subject of interstate commerce, dated March 22, 1907, and effective on and after April 15, 1907 (B. A. I. Order 143), be, and the same is hereby, amended as follows:

REGULATION 33:
(*a*) The tobacco dip; prepared from tobacco or from suitable tobacco products containing nicotine so as to produce a dipping bath which shall contain not less than seven one-hundredths of 1 per cent of nicotine.

The effect of this amendment is to discontinue the requirement that flowers of sulphur be used, and to require that when tobacco or tobacco products are used the dipping bath shall contain not less than seven one-hundredths of 1 per cent of nicotine.

Done at Washington this 18th day of April, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary*.

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AMENDMENT 9 TO B. A. I. ORDER 146.

## Amendment 9 to Rule 3, Revision 1.—To Prevent the Spread of Scabies in Sheep (Effective on and after May 1, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

The fact has been determined by the Secretary of Agriculture, and notice is hereby given, that the contagious and communicable disease known as scabies is not now known to exist, or exists to a slight extent only, among sheep in that part of the State of Oregon lying west of the Cascade Mountain Range, which area is now quarantined by Rule 3, Revision 1, dated March 22, 1907, and effective April 15, 1907.

Now, therefore, I, JAMES WILSON, SECRETARY OF AGRICULTURE, do hereby remove and revoke the quarantine placed by Rule 3, Revision 1, upon the following area, to wit:

That part of the State of Oregon lying west of the Cascade Mountain Range.

The effect of this order is to release from quarantine all of that portion of Oregon lying west of the Cascade Mountain Range.

Done at Washington this 18th day of April, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary.*

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AMENDMENT 10 TO B. A. I. ORDER 146.

## Amendment 10 to Rule 3, Revision 1.—To Prevent the Spread of Scabies in Sheep (Amendment Effective on and after August 7, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

It is ordered that the quarantine for scabies in sheep placed upon the State of Kentucky by amendment 4 to Rule 3, Revision 1, dated August 5, 1909, and effective on and after August 16, 1909, be, and the same is hereby, modified to permit the interstate shipment of sheep of States not quarantined for scabies in sheep which are exhibited at the Blue Grass Fair to be held at Lexington, Ky., August 7 to 12, 1911, inclusive, subject to the following restrictions:

(*a*) Such sheep shall be shipped by rail to Lexington and shall not be unloaded in the area quarantined for sheep scabies elsewhere than at Lexington.

(*b*) Separate cleaned and disinfected chutes and other facilities shall be provided for the exclusive unloading and loading of such sheep at Lexington.

(*c*) Such sheep shall be hauled in cleaned and disinfected wagons direct from the cars in which they arrive at Lexington to the fair grounds, and from the fair grounds direct to the cars in which they are to be reshipped.

(*d*) That portion of the fair grounds or other premises to be occupied exclusively by such sheep shall be cleaned and disinfected under the supervision of an employee of the Bureau of Animal Industry before said sheep are placed therein.

(*e*) Such sheep shall not be moved interstate from Lexington except in cleaned and disinfected cars, nor unless accompanied by a certificate issued by an inspector of the Bureau of Animal Industry showing that the sheep have had no opportunity to become infected with scabies.

Done at Washington this 26th day of July, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

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AMENDMENT 11 TO B. A. I. ORDER 146.

## Amendment 11 to Rule 3, Revision 1.—To Prevent the Spread of Scabies in Sheep (Amendment Effective on and after September 7, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

It is ordered that the quarantine for scabies in sheep placed upon the State of Kentucky by amendment 4 to Rule 3, Revision 1, dated August 5, 1909, and effective on and after August 16, 1909, be, and the same is hereby, modified to permit the interstate shipment of sheep of States not quarantined for scabies in sheep which are exhibited at the Kentucky State Fair, to be held at Louisville September 11 to 16, 1911, inclusive, subject to the following restrictions:

(*a*) Such sheep shall be shipped by rail to Louisville and shall not be unloaded in the area quarantined for sheep scabies elsewhere than at Louisville.

(*b*) Separate cleaned and disinfected chutes and other facilities shall be provided for the exclusive unloading and loading of such sheep at Louisville.

(*c*) Such sheep shall be hauled in cleaned and disinfected wagons direct from the cars in which they arrive at Louisville to the fair grounds, and from the fair grounds direct to the cars in which they are to be reshipped.

(*d*) That portion of the fair grounds or other premises to be occupied exclusively by such sheep shall be cleaned and disinfected under the supervision of an employee of the Bureau of Animal Industry before said sheep are placed therein.

(*e*) Such sheep shall not be moved interstate from Louisville except in cleaned and disinfected cars, nor unless accompanied by a certificate issued by an inspector of the Bureau of Animal Industry showing that the sheep have had no opportunity to become infected with scabies.

Done at Washington this 10th day of August, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] W. M. HAYS, *Acting Secretary of Agriculture.*

AMENDMENT TO B. A. I. ORDER 150.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
*Washington, D. C., November 29, 1911.*

Section 17, paragraph 1, of regulation 13, B. A. I. Order 150, "Regulations Governing the Meat Inspection of the United States Department of Agriculture," is hereby amended to read as follows:

*Section 17, Paragraph 1.*—(*a*) Carcasses of cattle affected with tapeworm cysts, known as *Cysticercus bovis*, shall be condemned if the infestation is excessive.

(*b*) In case the infestation is moderate the carcass may be rendered into tallow, provided the meat has not assumed an edematous or discolored appearance in consequence of the invasion.

(*c*) Carcasses of cattle which at the time of dressing show a slight infestation—that is, not to exceed twelve tapeworm cysts—may be passed for food after the removal of the parasites: *Provided*, Each half of the split carcass is cut after the flesh becomes firm into not less than twelve regular market cuts: *And further provided*, That each cut is appropriately identified by retained tag and held in a suitable cooler for not less than 21 days at a temperature not higher than 38° or solidly frozen at 12° F. and held in this condition for not less than 6 days as a further precautionary measure.

In case the incised surfaces of these market cuts show the presence of any additional tapeworm cysts, the infestation shall be considered more than slight and the carcass in its entirety shall be disposed of as provided in (*a*) and (*b*) above.

JAMES WILSON, *Secretary.*

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AMENDMENT 2 TO B. A I. ORDER 167.

## Amendment 2 to Rule 2, Revision 3.—To Prevent the Spread of Scabies in Cattle (Effective on and After June 1, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

The fact has been determined by the Secretary of Agriculture, and notice is hereby given, that the contagious disease known as scabies is not now known to exist, or exists to a slight extent only, among cattle in the counties of Tripp and Gregory, in the State of South Dakota; in the counties of Keyapaha, Wheeler, Garfield, Loup, Perkins, and that part of Lincoln County lying south of the Platte River, in the State of Nebraska; and in the counties of Wallace, Greeley, Wichita, Scott, and Gray, in the State of Kansas, quarantined by Rule 2, Revision 3, dated December 22, 1909, and effective January 15, 1910.

Now, therefore, I, JAMES WILSON, SECRETARY OF AGRICULTURE, under authority of law, do hereby amend said Rule 2, Revision 3, to prevent the spread of scabies in cattle, in the following particulars, to wit:

That part of said rule which specifies the quarantined portion of the State of South Dakota is amended to read as follows:

In SOUTH DAKOTA, the counties of Harding, Corson, Perkins, Schnasse, Dewey, Armstrong, Meade, Butte, Lawrence, Pennington, Stanley, Lyman, Mellette, Washabaugh, Washington, Custer, Fall River, Shannon, Bennett, and Todd.

That part of said rule which specifies the quarantined portion of the State of Nebraska is amended to read as follows:

In NEBRASKA, the counties of Sioux, Scotts Bluff, Banner, Kimball, Cheyenne, Boxbutte, Dawes, Sheridan, Deuel, Keith, McPherson, Grant, Cherry, Hooker, Thomas, Logan, Blaine, Brown, Rock, Holt, Morrill, and that part of Lincoln County lying north of the Platte River.

That part of said rule which specifies the quarantined portion of the State of Kansas is amended to read as follows:

In KANSAS, the counties of Hamilton, Stanton, Morton, Stevens, Grant, Kearny, Finney, Haskell, Seward, Meade, and Clark.

The effect of this order is to release from quarantine on account of scabies in cattle the counties of Tripp and Gregory, in the State of South Dakota; the counties of Keyapaha, Wheeler, Garfield, Loup, Perkins, and that part of Lincoln County lying south of the Platte River, in the State of Nebraska; and the counties of Wallace, Greeley, Wichita, Scott, and Gray, in the State of Kansas.

Done at Washington this 17th day of May, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

AMENDMENT 3 TO B. A. I. ORDER 168.

**Amendment 3 to Rule 1, Revision 6.—To prevent the Spread of Splenetic Fever in Cattle. Amendment Regarding the Return of Cattle of the Nonquarantined Area that are Exhibited at the National Feeders and Breeders' Show at Fort Worth, Tex., March 13 to 18, 1911.**

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

It is ordered that that portion of Rule 1, Revision 6, to prevent the spread of splenetic fever in cattle, effective on and after April 1, 1910, which relates to the quarantine in the State of Texas, is hereby modified to permit the interstate shipment to points outside the quarantined area as uninfected cattle of cattle of the nonquarantined area that are exhibited at the National Feeders and Breeders' Show, to be held at Fort Worth, Tex., March 13 to 18, 1911, subject to the following restrictions:

(*a*) Such cattle shall be shipped by rail to Fort Worth, and shall not be unloaded in the quarantined area elsewhere than at Fort Worth.

(*b*) Separate cleaned and disinfected chutes and other facilities shall be provided for the exclusive unloading and loading of such cattle at Fort Worth.

(*c*) That portion of the show grounds and other premises to be occupied by such cattle shall have been inaccessible to other cattle for at least six months previous to the date of the opening of the show.

(*d*) The hay, straw, or similar material required for feed and bedding by such cattle during the time they are within the quarantined area shall be shipped in cleaned and disinfected cars from points outside of the quarantined area and so handled at Fort Worth that it may not become infectious.

(*e*) Such cattle shall not be returned from Fort Worth to points outside of the quarantined area except in cleaned and disinfected cars, nor unless accompanied by a certificate issued by an inspector of the Bureau of Animal Industry, showing that such cattle have had no opportunity to become infected with the cattle tick (*Margaropus annulatus*).

Done at Washington this 25th day of January, 1911. Witness my hand and the seal of the Department of Agriculture.

[SEAL.] W. M. HAYS, *Acting Secretary.*

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AMENDMENT 2 TO B. A. I. ORDER 175.

**Amendment 2 to B. A. I. Order 175 (Regulations of the Secretary of Agriculture Governing the Certification of Recognized Breeds and Purebred Animals). Modifying Paragraph 1, Section 4, Regulation 2, Regarding the Recognition of Breeds and Books of Record Across the Seas.**

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

Paragraph 1, section 4, Regulation 2, of the regulations issued by the Secretary of Agriculture under date of November 25, 1910, regarding the recognition of breeds and books of record across the seas, under the heading "Horses," is hereby amended to indicate the Australian Jockey Club and Victoria Racing Club (A. P. Wilson, keeper, 6 Bligh Street, Sidney, New South Wales) as custodian of the Australian Thoroughbred Studbook.

It is further provided that no animal or animals registered in the Australian Thoroughbred Studbook shall be accepted as purebred unless such animal or animals trace in all crosses to animals registered in the General Studbook of England.

Done at Washington this 1st day of February, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

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AMENDMENT 3 TO B. A. I. ORDER 175.

**Amendment 3 to B. A. I. Order 175 (Regulations Governing the Certification of Recognized Breeds and Purebred Animals). Modifying Paragraph 1, Section 4, Regulation 2, Regarding the Recognition of Cats Registered in the Register of the Governing Council of the Cat Fancy (Effective on and after April 3, 1911).**

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

Paragraph 1, section 4, Regulation 2, of the regulations issued by the Secretary of Agriculture under date of November 25, 1910, regarding the recognition of breeds and

books of record across the seas, under the heading "Cats," is hereby amended so as to substitute the Governing Council of the Cat Fancy for the National Cat Club of England. Hereafter the recognized breeds and book of record across the seas in the case of cats will, until otherwise ordered, be as follows:

CATS.

| Name of breed. | Book of record. | By whom published. |
|---|---|---|
| Long haired and short haired.... | Register of the Governing Council of the Cat Fancy. | The Governing Council of the Cat Fancy, S. Desborough, secretary, 65 and 66 Chancery Lane, London, W. C., England. |

Done at Washington this 29th day of March, 1911.
Witness my hand and the seal of the Department of Agriculture.
[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

AMENDMENT 4 TO B. A. I. ORDER 175.

**Amendment 4 to B. A. I. Order 175 (Regulations of the Secretary of Agriculture Governing the Certification of Recognized Breeds and Purebred Animals). Modifying Regulation 2, Section 4, Paragraph 2, and Amendment 1 Regarding the Recognition of Animals Registered in the Canadian National Records (Effective on and after June 1, 1911).**

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

Regulation 2, section 4, paragraph 2, of the regulations issued by the Secretary of Agriculture under date of November 25, 1910, and amendment 1 thereto issued December 30, 1910, regarding the recognition of specific breeds of horses, cattle, sheep, and hogs registered in the Canadian National Records, is hereby modified so as to provide that no animal or animals registered in the Canadian National Records shall be certified by the Secretary of Agriculture as purebred except those which trace, in all crosses, to registered animals in the country where the breed originated, or to animals which are proved to the satisfaction of the department to be of the same breed and that have been imported into the United States or Canada from the country in which the breed originated.

Done at Washington this 31st day of May, 1911.
Witness my hand and the seal of the Department of Agriculture.
[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

AMENDMENT 5 TO B. A. I. ORDER 175.

**Amendment 5 to B. A. I. Order 175 (Regulations of the Secretary of Agriculture Governing the Certification of Recognized Breeds and Purebred Animals). Modifying Regulation 2, Section 4, Paragraph 1, Regarding Recognized Breeds of Domestic Animals and Books of Record Across the Seas, and Regulation 2, Section 4, Paragraph 2, Regarding the Recognition of Animals Rgistered in the Canadian National Records (Effective on and after September 25, 1911).**

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

Regulation 2, section 4, paragraph 1, of the regulations issued by the Secretary of Agriculture under date of November 25, 1910, regarding recognized breeds of domestic animals and books of record across the seas, is hereby modified so as to include under the heading "Sheep" the following:

| Name of breed. | Book of record. | By whom published. |
|---|---|---|
| Kerry Hill..... | Kerry Hill Flock Book..... | Kerry Hill (Wales) Flock Book Society, Morris, Marshall & Poole, secretaries, Chirbury, Shropshire, England. |

Regulation 2, section 4, paragraph 2, of the regulations issued by the Secretary of Agriculture under date of November 25, 1910, regarding the recognition of specific breeds of horses, cattle, sheep, and hogs registered in the Canadian National Records, is hereby modified so as to provide that hereafter the Canadian National Records for standardbred horses are hereby recognized, subject to the same provisions prescribed for books of record across the seas, and regulation 2, section 4, paragraph 2, of B. A. I. Order 175 is amended accordingly; and no horse or horses registered in the said Canadian National Records for standardbred horses shall be certified by the Secretary of Agriculture as purebred except those which trace, in all crosses, to registered horses in the country where the breed originated.

Done at Washington this 28th day of September, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

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AMENDMENT 6 TO B. A. I. ORDER 175.

## Amendment 6 to B. A. I. Order 175 (Regulations of the Secretary of Agriculture Governing the Certification of Recognized Breeds and Purebred Animals). Modifying Regulation 2, Section 4, Paragraph 1, Regarding the Recognized Breeds of the Domestic Animals and Books of Record Across the Seas (Effective on and after December 1, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

Regulation 2, section 4, paragraph 1, of the regulations issued by the Secretary of Agriculture under date of November 25, 1910, regarding recognized breeds of domestic animals and books of record across the seas, is hereby modified so as to include under the heading "Hogs" the following:

| Name of breed. | Book of record. | By whom published. |
|---|---|---|
| Large Black..... | Large Black Pig Herdbook.... | Large Black Pig Society, W. J. Wickison, secretary, 12 Hanover Square, London, W., England. |

Done at Washington this 29th day of November, one thousand nine hundred and eleven.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

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B. A. I. ORDER 178.

## Rule 1, Revision 7.—To Prevent the Spread of Splenetic, Southern, or Texas Fever in Cattle (Effective on and After March 15, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

The fact has been determined by the Secretary of Agriculture, and notice is hereby given, that a contagious and infectious disease known as splenetic, southern, or Texas fever exists among cattle in the following-named States, to wit:

CALIFORNIA, OKLAHOMA, TEXAS, MISSOURI, ARKANSAS, LOUISIANA, MISSISSIPPI, TENNESSEE, ALABAMA, VIRGINIA, NORTH CAROLINA, SOUTH CAROLINA, GEORGIA, and FLORIDA.

Now, therefore, I, W. M. HAYS, ACTING SECRETARY OF AGRICULTURE, under authority conferred by section 1 of the act of Congress approved March 3, 1905 (33 Stat., 1264), do hereby quarantine the area hereinafter described, and do order by this Rule 1, Revision 7, under the authority and discretion conferred on the Secretary of Agriculture by section 3 of the act of Congress approved March 3, 1905 (33 Stat., 1265), that the interstate movement of cattle of the area herein quarantined to any point not located in the said quarantined area shall be made only in accordance with the regulations of the Secretary of Agriculture, designated as B. A. I. Order 143, promulgated March 22, 1907, and effective April 15, 1907, and amendments thereto, subject only to the exceptions hereinafter contained.

The following areas are quarantined for splenetic, southern, or Texas fever in cattle:

CALIFORNIA.

The counties of San Diego, Orange, Santa Barbara County with the exception of the island of Santa Rosa, and that part of San Luis Obispo County located south and west of a line beginning at the point of the intersection of the township line between township 32 south, range 17 east, and township 32 south, range 18 east, with the Santa Maria River on the southern boundary of the county of San Luis Obispo, and extending northerly on said township line between township 32 south, range 17 east, and township 32 south, range 18 east, and on township line between township 31 south, range 17 east, and township 31 south, range 18 east, to its intersection with the summit of the Santa Lucia range of mountains; thence following the summit of the Santa Lucia range of mountains northwesterly to its intersection with the northern boundary line of San Luis Obispo County.

During the continuance of this quarantine no cattle of the area hereinbefore described shall be moved or allowed to move, except as provided for immediate slaughter, to any point in the United States not in the State of California which is located in an area not quarantined for splenetic, southern, or Texas fever unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months, and unless and until the cattle shall have been inspected and found free of infection and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped.

TEXAS.

The entire State of Texas is quarantined with the exception of the counties of Dallam, Sherman, Hansford, Ochiltree, Lipscomb, Hartley, Moore, Hutchinson, Roberts, Hemphill, Oldham, Potter, Carson, Gray, Wheeler, Deaf Smith, Randall, Armstrong, Donley, Collingsworth, Parmer, Castro, Swisher, Briscoe, Hall, Childress, Bailey, Lamb, Hale, Floyd, Motley, Cottle, Cochran, Hockley, Lubbock, Crosby, Dickens, Yoakum, Terry, Lynn, Garza, Kent, Gaines, Dawson, Andrews, Martin, El Paso, Jeff Davis, Presidio, Brewster, Reeves, Loving, Winkler, Ector, Midland, Ward, Scurry, Borden, Glasscock, Crane, and Upton; that part of Hardeman County north of the Fort Worth & Denver City Railway; those parts of Howard and Mitchell Counties north of the Texas & Pacific Railway; and those parts of the counties of Pecos and Terrell north and west of a line beginning at the southwest corner of Terrell County; thence in a northerly direction to the northwest corner of section No. 63, block D10, Texas Central Railway Co.; thence north along the western boundary of sections Nos. 64, 65, 66, 67, 68, 69, 70, 71, and 72 of said block D10 to the northwest corner of said section No. 72; thence continuing north through the western parts of sections Nos. 36, 25, 24, 13, 12, and 1, block 150, Texas & St. Louis Railroad Co., to the roadbed of the Galveston, Harrisburg & San Antonio Railroad Co.; thence southeasterly, following the roadbed of the said Galveston, Harrisburg & San Antonio Railroad Co., to a point on section No. 36, block A2, Galveston, Harrisburg & San Antonio Railroad Co.; thence north with the pasture fence through the eastern part of sections Nos. 36, 13, and 12 of said block A2 and across section No. 1, Gulf, Colorado & Santa Fe Railroad Co.; thence continuing north with said pasture fence through the eastern part of sections Nos. 16, 17, 46, 47, 76, 77, 106, 107, 136, 137, 142, 143, and 194, block D, Missouri, Kansas & Texas Extension Railway Co.; thence continuing in a northerly direction to a point on the northern boundary of section No. 6, block 160, Gulf, Colorado & Santa Fe Railway Co., same being corner of pasture fence; thence east along the northern boundary of sections Nos. 6, 9, 10, 11, 12, 15, and 16, block 160, Gulf, Colorado & Santa Fe Railway Co., to the northeast corner of said section No. 16, the same being corner of pasture fence; thence in a northerly direction with the eastern boundary of sections Nos. 22, 21, 20, 23, 24, 25, 26, 27, 28. 29, 30, 31, and 32, block 1, Corpus Christi, San Diego & Rio Grande Narrow Gauge Railway Co., to the northeast corner of said section No. 32; thence west with the northern boundary of sections Nos. 32 and 33, same block, to the northwest corner of section No. 33, block 1, Corpus Christi, San Diego & Rio Grande Narrow Gauge Railway Co., corner of fence; thence north with the eastern boundary of sections Nos. 1, 12, 13, 24, 25, 36, 37, 48, 49, 60, 61, and 72, block 2, Corpus Christi, San Diego & Rio Grande Narrow Gauge Railway Co., to the northeast corner of said section No. 72; thence in an easterly direction with the pasture fence to the southeast corner of section No. 9, patented to James E. Evans; thence north along the eastern boundary of said section No. 9 to the northwest corner of section No. 100, block A2, Texas Central Railway Co.; thence east with the northern boundary of sections Nos. 100 and 89, same block, to the northeast corner of said section No. 89, block A2, Texas Central Railway Co.; thence north along the eastern boundary of sections Nos. 90, 91, 92, and 93 to the southeast corner of section No. 94, block A2, Texas

Central Railway Co.; thence northwest diagonally across section No. 94 to the northwest corner of said section; thence continuing in a northwesterly direction diagonally across sections Nos. 14, 18, and 28 to the northeast corner of section No. 29, block C4, Gulf, Colorado & Santa Fe Railway Co.; thence west with the northern boundary of said section No. 29 to the northwest corner of said section; thence northwest diagonally across section No. 1, Texas Central Railway Co., and section No. 97, block 194, Gulf, Colorado & Santa Fe Railway Co., to the northeast corner of section No. 96; thence in a northerly direction across section No. 94 to a point in its northern boundary 600 varas west of its northeast corner; thence continuing north through sections Nos. 93, 90, 89, 86, 85, and 58, block 194, Gulf, Colorado & Santa Fe Railway Co., to a point on the northern boundary of said section No. 58; thence northwesterly with the pasture fence through section No. 59 to the northeast corner of section No. 82 and the southeast corner of section No. 81, same block; thence continuing northwesterly to section No. 17, Houston & Great Northern Railroad Co.; thence north along the eastern boundary of said section No. 17 to the Pecos River; thence northwesterly along said Pecos River to the northwest corner of Crockett County.

During the continuance of this quarantine no cattle of the counties of King, Stonewall, Fisher, Jones, and Reagan; those parts of the counties of Foard, Knox, and Haskell west of the Kansas City, Mexico & Orient Railway; that part of Hardeman County south of the Fort Worth & Denver City Railway and west of the Kansas City, Mexico & Orient Railway, or of those parts of Howard and Mitchell Counties south of the Texas & Pacific Railway, shall be moved or allowed to move, except as provided for immediate slaughter, to any point in the United States not in the State of Texas which is located in an area not quarantined for splenetic, southern, or Texas fever unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months, and unless and until the cattle shall have been inspected and found free of infection and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped. Each application for inspection shall be duly made by the owner or the manager of the cattle on blank forms furnished by the department, and should be placed in the hands of the inspector of the Bureau of Animal Industry in charge of the district not less than 10 days in advance of the date on which inspection is required. Such applications for inspection shall be accompanied by affidavits when required by the said inspector.

From the other counties and parts of counties in the State of Texas quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

OKLAHOMA.

The entire State of Oklahoma is quarantined except the counties of Cimarron, Texas, Beaver, Harper, Woods, Alfalfa, Grant, Woodward, Major, Garfield, Ellis, Dewey, Blaine, Kingfisher, Logan, Roger Mills, Custer, Beckham, Washita, Greer, Kiowa, Caddo, Jackson, Oklahoma, Harmon, and Canadian; that part of Cleveland County north of the line between townships 7 and 8 north, and west of the Indian meridian; that part of Noble County not included in townships 22 and 23 north, range 2 east, and those parts of townships 22 and 23 north, range 1 east, which is east of the Atchison, Topeka & Santa Fe Railway; that part of Kay County west of the Arkansas River; that part of Payne County west and north of a line commencing at the northeast corner of township 20 north, range 4 east, Indian meridian; thence south to line between townships 19 and 20 north; thence west to line between ranges 3 and 4 east, Indian meridian; thence south to line between townships 18 and 19 north; thence west to line between ranges 2 and 3 east, Indian meridian; thence south to line between townships 17 and 18 north; thence west to line between ranges 1 and 2 east, Indian meridian; thence south to the northwest corner of Lincoln County; that part of Swanson County north of the line between townships 4 and 5 north; that part of Pottawatomie County included in townships 10 and 11 north, range 2 east; that part of Pawnee County north of the line between townships 20 and 21 north and west of the line between ranges 5 and 6 east; and that part of Lincoln County west and south of the line beginning at the intersection of the Atchison, Topeka & Santa Fe Railway with the southern boundary line of Lincoln County; thence following said railway in a northerly direction to its intersection with the Fort Smith & Western Railroad; thence following the said railroad in a westerly direction to its intersection with the St. Louis & San Francisco Railroad; thence westerly following said railroad to its intersection with the western boundary line of Lincoln County.

From the counties and parts of counties in the State of Oklahoma quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

MISSOURI.

Ripley County, that part of Oregon County south of the line between townships 22 and 23 north, that part of Newton County west of the right of way of the Kansas City Southern Railway, and that part of McDonald County west of the right of way of Kansas City Southern Railway are quarantined.

During the continuance of this quarantine no cattle of those parts of Oregon, Newton, and McDonald Counties hereinbefore described shall be moved or allowed to move, except as provided for immediate slaughter, to any point in the United States not in the State of Missouri which is located in an area not quarantined for splenetic, southern, or Texas fever, unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months, and unless and until the said cattle shall have been inspected and found free of infection and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped.

From Ripley County cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

ARKANSAS.

The entire State of Arkansas is quarantined except the counties of Carroll, Randolph, Clay, Greene, Lawrence, Craighead, Mississippi, Poinsett, Benton, and Washington.

During the continuance of this quarantine no cattle of that part of Fulton County east of Spring River, or that part of Sharp County north of Strawberry River, shall be moved or allowed to move, except as provided for immediate slaughter, to any point in the United States not in the State of Arkansas which is located in an area not quarantined for splenetic, southern, or Texas fever, unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months, and unless and until the cattle shall have been inspected and found free of infection and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped.

From the other counties and parts of counties in the State of Arkansas quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

MISSISSIPPI.

The entire State of Mississippi is quarantined except the counties of De Soto, Tate, Tunica; that part of Marshall County north and west of the Illinois Central Railroad, and that part of Benton County north of Tippah Creek.

From the counties and parts of counties in the State of Mississippi quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

TENNESSEE.

The following-mentioned counties and parts of counties are quarantined: The counties of Hardeman, McNairy, Chester, Henderson, Decatur, Hardin, Wayne, and Hamilton; that part of Marion County south and east of the Tennessee River; that part of Polk County north of the Hiawassee River; that part of Lawrence County south of the line beginning where the Pulaski and Lawrenceburg public road intersects the Giles County line; thence in a westerly direction following said road to Lawrenceburg; thence following the Waterloo road west 2 miles; thence northwesterly following the Lawrenceburg and Waynesboro public road to its intersection with the Wayne County line; and that part of Benton County west of the Camden, Coxburg, and Sugar Tree public road and south of the Nashville, Chattanooga & St. Louis Railway from its intersection with the said public road at Camden to the Carroll County line.

From the counties and parts of counties in the State of Tennessee quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

GEORGIA.

The entire State of Georgia is quarantined except the counties of Union, Towns, Rabun, White, Habersham, and Stephens.

From the counties in the State of Georgia quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

SOUTH CAROLINA.

The entire State of South Carolina is quarantined except the counties of Oconee, Pickens, Greenville, and Anderson.

From the counties in the State of South Carolina quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

NORTH CAROLINA.

The counties of Moore, Lee, Harnett, Johnston, Wilson, Nash, Halifax, Northampton, Hertford, Bertie, Gates, Chowan, Perquimans, Pasquotank, Camden, Currituck, Edgecombe, Martin, Washington, Tyrrell, Dare, Hyde, Beaufort, Pitt, Wayne, Sampson, Cumberland, Richmond, Scotland, Robeson, Bladen, Greene, Lenoir, Craven, Pamlico, Carteret, Jones, Duplin, Onslow, Pender, Columbus, Brunswick, and New Hanover are quarantined.

From the counties in the State of North Carolina quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

VIRGINIA.

The counties of Greenesville, Sussex, Surry, Southampton, Isle of Wight, and Nansemond; that part of Warwick County not included in the Newport News magisterial district; and that part of York County not included in the Bruton magisterial district are quarantined.

From the counties and parts of counties in the State of Virginia quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

LOUISIANA.

The entire State of Louisiana is quarantined.

During the continuance of this quarantine no cattle of the parishes of Lincoln and Claiborne shall be moved or allowed to move, except as provided for immediate slaughter, to any point in the United States not in the State of Louisiana which is located in an area not quarantined for splenetic, southern, or Texas fever, unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months, and unless and until the cattle shall have been inspected and found free of infection and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped.

From the other parishes in the State of Louisiana quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

ALABAMA, FLORIDA.

The entire States of Alabama and Florida are quarantined.

From the States of Alabama and Florida cattle shall only be moved or allowed to move to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

GENERAL PROVISIONS.

During the continuance of the quarantine as herein established no cattle of the quarantined area of any State (except those portions from which cattle may be moved upon inspection) shall be moved or allowed to move to any portion of the quarantined area of another State from which, under the specific provisions of this rule, cattle are allowed to be shipped for purposes other than immediate slaughter upon inspection and certification by an inspector of the Bureau of Animal Industry.

In case cattle are moved or allowed to move from the area quarantined for splenetic, southern, or Texas fever in violation of the rule and regulations of this department to prevent the spread of splenetic fever in cattle, such cattle shall be immediately returned to such quarantined area or they shall be quarantined.

OPEN SEASON.

During the months of January, November, and December of each year cattle of the quarantined area of any State may be moved interstate therefrom for purposes other than immediate slaughter into the State of Kansas, the Territories of Arizona and New Mexico, those parts of the States of California and Texas not included in the quarantined area, and that part of the State of Missouri south of the Missouri River if the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months and shall first have been inspected under proper facilities for inspection at the point of origin and found free of infection and a certificate authorizing the movement issued by an inspector of the Bureau of Animal Industry, and if permission shall first have been obtained from the proper official of the State or Territory to which the cattle are destined.

During the period from November 15 of each year to January 31 of the following year cattle of the quarantined area of any State may be moved interstate therefrom for purposes other than immediate slaughter under the above-mentioned restrictions into that part of the State of Arkansas not included in the quarantined area.

During the months of January and February, the first 15 days of March, and the last 16 days of December in each year cattle of the quarantined area of any State may be moved interstate therefrom for purposes other than immediate slaughter under the above-mentioned restrictions into those parts of the States of Virginia and South Carolina not included in the quarantined area.

During the month of January and the last 17 days of December in each year cattle of the quarantined area of any State may be moved interstate therefrom for purposes other than immediate slaughter under the above-mentioned restrictions into that part of the State of Oklahoma not included in the quarantined area.

Cattle of the quarantined area that have been shipped interstate during the months of January, November, and December of each year to any State or Territory outside of the quarantined area other than those States or Territories and parts thereof set out herein, shall not be moved into any of the States or Territories or parts thereof hereinbefore mentioned within three months of the date of the movement from the quarantined area.

Cattle which are moved interstate from the quarantined area of any State into those States or Territories or parts thereof hereinbefore mentioned, under certificates from inspectors of the Bureau of Animal Industry, for feeding or stocking purposes, shall, when shipped, be transported in cleaned and disinfected cars or boats, and shall not be placed in stock pens which have been reserved for cattle originating in the quarantined area.

FEEDING STATIONS FOR NONINFECTED CATTLE.

Cattle not of the quarantined area which are transported interstate by rail through the quarantined area may be unloaded therein for rest, feed, and water into properly equipped noninfectious pens set apart for such cattle at the Fort Worth Stockyards at Fort Worth, Tex.; the stockyards of the Missouri, Kansas & Texas Railway, at Hodge and Denison, Tex.; the stockyards of the International & Great Northern Railroad, at Laredo, Tex.; the stockyards of the Texas & Pacific Railway, at Baird, Tex.; the stockyards of the St. Louis & San Francisco Railroad, at Sapulpa, Okla.; the stockyards of the Missouri, Kansas & Texas Railway, at Muskogee, Okla.; the stockyards of the Kansas City, Mexico & Orient Railway, at Altus, Okla.; and at such other points as may from time to time be authorized by the Secretary of Agriculture, provided such pens and the platforms, chutes, and alleyways leading thereto have been cleaned and disinfected under the supervision of an employee of the Bureau of Animal Industry and are constructed and maintained in accordance with the specifications set out in the regulations of the Secretary of Agriculture to prevent the spread of splenetic fever in cattle.

All cattle handled in such noninfectious pens shall be free from ticks (*Margaropus annulatus*) and shall not have been unloaded at any point in the quarantined area other than the designated unloading points named herein or hereafter authorized by the Secretary of Agriculture, and they shall be reloaded into the same cars from which unloaded, or into other cars which have been cleaned, washed, and disinfected, as required by B. A. I. Order 143, and amendments thereto, immediately before loading therein, and reshipped as uninfected cattle.

ARSENICAL SOLUTION.

In accordance with the provisions of Regulation 17 of the Regulations of the Secretary of Agriculture governing the inspection, disinfection, certification, treatment, handling, and method and manner of delivery and shipment of live stock which is the subject of interstate commerce, cattle of the area quarantined on account of splenetic, southern, or

Texas fever or other cattle infested with or exposed to ticks (*Margaropus annulatus*) may be dipped, under the supervision of an inspector of the Bureau of Animal Industry, in the standard arsenical solution, and when properly certified by said inspector to be free of infection may be shipped interstate for purposes other than immediate slaughter, subject only to such restrictions as may be imposed by the authorities at destination; provided, that such cattle shall be dipped twice, with an interval of from 7 to 10 days between the first and second dippings; that the cattle shall be considered infectious and shall be handled as such during the interval between dippings; that the cattle shall not be exposed to infection after the second dipping; and that the facilities for preparing the dip and dipping the cattle shall first have been approved by the Chief of the Bureau of Animal Industry.

In preparing each 500 gallons of the standard arsenical solution there shall be used 10 pounds of finely powdered white arsenic containing not less than 99 per cent of arsenic trioxid, 25 pounds of sal soda, and 1 gallon of pine tar. The arsenic and sal soda shall be boiled together in not less than 25 gallons of water for 15 minutes, or longer if necessary, to effect complete solution of the arsenic. Before the pine tar is added the temperature of the solution shall be reduced to 140° F. This may be done by the addition of cold water. The pine tar shall then be added in a small stream while the solution is thoroughly stirred, after which the solution shall be immediately diluted with clear water sufficient to make 500 gallons of dip.

INTERPRETATION.

This Rule 1, Revision 7, shall be construed in connection with the Regulations of the Secretary of Agriculture promulgated March 22, 1907 (B. A. I. Order 143), and effective on and after April 15, 1907, and amendments thereto, and is subject to amendment or revision on statutory notice.

Rule 1, Revision 6, dated March 12, 1910, effective April 1, 1910, shall cease to be effective on and after March 15, 1911, on and after which date this Rule 1, Revision 7, which for purposes of identification is designated as B. A. I. Order 178, shall become and be effective until otherwise ordered.

The effect of this order is as follows:

In Texas the county of Cottle and portions of the counties of Hardeman, Howard, and Mitchell are released from quarantine.

In Oklahoma the county of Kiowa and portions of the counties of Greer, Jackson, Swanson, Caddo, Cleveland, Pottawatomie, Lincoln, and Pawnee are released from quarantine.

In Mississippi portions of the counties of Marshall and Benton are released from quarantine.

In Tennessee the county of Overton and portions of the counties of Fentress, Polk, Lincoln, Lawrence, Benton, and Madison are released from quarantine.

In North Carolina the counties of Stanly, Montgomery, Randolph, Chatham, Wake, and Franklin are released from quarantine.

In Virginia the counties of Fluvanna and Chesterfield are released from quarantine.

The open season for North Carolina is discontinued.

Baird, Tex., is added to the list of feeding stations for noninfected cattle.

Cattle moved from the quarantined area in violation of the rule and regulations shall be returned or quarantined.

Done at Washington this 9th day of March, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] W. M. HAYS, *Acting Secretary of Agriculture.*

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AMENDMENT 1 TO B. A. I. ORDER 178.

## Amendment 1 to Rule 1, Revision 7.—To prevent the Spread of Splenetic, Southern, or Texas Fever in Cattle (Effective on and after June 1, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

Whereas an error has occurred in the description of the quarantine of Polk County, within the State of Tennessee, quarantined for splenetic, southern, or Texas fever among cattle in Rule 1, Revision 7 (B. A. I. Order 178), dated March 9, 1911, and effective on and after March 15, 1911.

Now, therefore, it is hereby ordered that the description of the part of Polk County, within the State of Tennessee, quarantined for splenetic, southern, or Texas fever among cattle which reads in Rule 1, Revision 7 (B. A. I. Order 178), "that part of Polk

County north of the Hiawassee River" is hereby amended to read "that part of Polk County *south* of the Hiawassee River," and that the provisions of Rule 1, Revision 7, applicable to the counties and parts of counties within the State of Tennessee therein quarantined shall also be applicable to the quarantine of the portion of Polk County as hereby amended.

This amendment, which for purposes of identification is designated as Amendment 1 to B. A. I. Order 178, shall be effective on and after June 1, 1911.

Done at Washington this 19th day of May, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

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AMENDMENT 2 TO B. A. I. ORDER 178.

**Amendment 2 to Rule 1, Revision 7.—To Prevent the Spread of Splenetic Fever in Cattle. Amendment Regarding the Return of Cattle of the Nonquarantined Area That Are Exhibited at the Georgia State Fair at Macon, Ga., October 10 to 20, 1911.**

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

It is ordered that that portion of Rule 1, Revision 7, to prevent the spread of splenetic fever in cattle, effective on and after March 15, 1911, which relates to the quarantine in the State of Georgia, is hereby modified to permit the interstate shipment to points outside the quarantined area as uninfected cattle, of cattle of the nonquarantined area that are exhibited at the Georgia State Fair, to be held at Macon, Ga., October 10 to 20, 1911, subject to the following restrictions:

(*a*) Such cattle shall be shipped by rail to Macon, and shall not be unloaded in the quarantined area elsewhere than at Macon.

(*b*) Separate cleaned and disinfected chutes and other facilities shall be provided for the exclusive unloading and loading of such cattle at Macon.

(*c*) Such cattle shall be hauled in clean and disinfected wagons direct from the cars in which they arrive at Macon to the fair grounds, and from the fair grounds direct to the cars in which they are to be reshipped.

(*d*) That portion of the fair grounds and other premises to be occupied by such cattle shall have been inaccessible to other cattle for at least six months previous to the date of the opening of the fair.

(*e*) The hay, straw, or similar material required for feed and bedding by such cattle during the time they are within the quarantined area shall be shipped in cleaned and disinfected cars from points outside of the quarantined area and so handled at Macon that it may not become infectious.

(*f*) Such cattle shall not be returned from Macon to points outside of the quarantined area, except in cleaned and disinfected cars, nor unless accompanied by a certificate issued by an inspector of the Bureau of Animal Industry, showing that such cattle have had no opportunity to become infected with the cattle tick (*Margaropus annulatus*).

Done at Washington this 8th day of August, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] W. M. HAYS, *Acting Secretary of Agriculture.*

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AMENDMENT 3 TO B. A. I. ORDER 178.

**Amendment 3 to Rule 1, Revision 7.—To Prevent the Spread of Splenetic Fever in Cattle. Amendment Regarding the Return of Cattle of the Nonquarantined Area that are Exhibited at the Mississippi-Alabama Fair at Meridian, Miss., October 16 to 21, 1911.**

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

It is ordered that that portion of Rule 1, Revision 7, to prevent the spread of splenetic fever in cattle, effective on and after March 15, 1911, which relates to the quarantine in the State of Mississippi, is hereby modified to permit the interstate shipment to points outside the quarantined area as uninfected cattle, of cattle of the nonquarantined area that are exhibited at the Mississippi-Alabama Fair, to be held at Meridian, Miss., October 16 to 21, 1911, subject to the following restrictions:

(*a*) Such cattle shall be shipped by rail to Meridian, and shall not be unloaded in the quarantined area elsewhere than at Meridian.

(*b*) Separate cleaned and disinfected chutes and other facilities shall be provided for the exclusive unloading and loading of such cattle at Meridian.

(*c*) Such cattle shall be hauled in clean and disinfected wagons direct from the cars in which they arrive at Meridian to the fair grounds, and from the fair grounds direct to the cars in which they are to be reshipped.

(*d*) That portion of the fair grounds and other premises to be occupied by such cattle shall have been inaccessible to other cattle for at least six months previous to the date of the opening of the fair.

(*e*) The hay, straw, or similar material required for feed and bedding by such cattle during the time they are within the quarantined area shall be shipped in cleaned and disinfected cars from points outside of the quarantined area and so handled at Meridian that it may not become infectious.

(*f*) Such cattle shall not be returned from Meridian to points outside of the quarantined area except in cleaned and disinfected cars, nor unless accompanied by a certificate issued by an inspector of the Bureau of Animal Industry showing that such cattle have had no opportunity to become infected with the cattle tick (*Margaropus annulatus*).

Done at Washington, this 13th day of September, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] W. M. HAYS, *Acting Secretary of Agriculture.*

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B. A. I. ORDER 179.

## Order Prescribed in Regard to the Admission of Tick-Infested Cattle from Mexico into Texas.

WASHINGTON, D. C., *March 9, 1911.*

The following order in regard to the admission of tick-infested cattle from Mexico into that part of Texas below the southern cattle quarantine line is issued jointly by the Secretary of the Treasury and the Secretary of Agriculture, under authority of the agricultural appropriation act of March 4, 1911 (Public, No. 478). This order shall become and be effective on and after March 16, 1911.

FRANKLIN MACVEAGH,
*Secretary of the Treasury.*

W. M. HAYS,
*Acting Secretary of Agriculture.*

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All tick-infested cattle offered for importation from the Republic of Mexico into that part of Texas below the southern cattle quarantine line shall, in accordance with the agricultural appropriation act of March 4, 1911 (Public, No. 478), be imported only through the following ports: Eagle Pass, Laredo, Brownsville, Galveston, Port Arthur, and Texas City, and be accompanied by an affidavit of the owner, stating that such cattle have been in the district from which shipped for six months next preceding the date of importation; that no contagious, infectious, or communicable disease has existed among them, nor among any animals with which they have come in contact for six months last passed, except the so-called Texas or splenetic fever; also by affidavit of the importer or his agent supervising the shipment, stating that the cattle have not passed through any district infected with contagious diseases affecting animals of their kind, except the so-called Texas or splenetic fever; that they have not been exposed in any possible manner to the contagion of any contagious disease, except the so-called Texas or splenetic fever; and that the animals, when not driven, have been shipped in cars and vessels which have been cleaned and disinfected, except as to ticks. When such cattle are not accompanied by the affidavits hereinbefore described, they shall be detained in quarantine at the port of entry at the expense of the owner or importer, under the supervision of the inspector, for such period as may be necessary to determine whether or not such cattle are entitled to entry under the regulations of, and in the discretion of, the Secretary of Agriculture. During this detention in quarantine a rigid inspection by an inspector of the Bureau of Animal Industry of the Department of Agriculture shall be made, including the tuberculin test if deemed necessary. All such cattle, when entered, shall be subject to the regulations governing the handling and transportation of cattle from the districts infected with southern, Texas, or splenetic fever.

B. A. I. ORDER 180.

## Regulations for the Inspection and Quarantine of Horses, Cattle, Sheep, Swine, and Other Animals Imported Into the United States.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
*Washington, D. C., April 5, 1911.*

Under authority of sections 7, 8, and 10 of the act of Congress approved August 30, 1890, entitled "An act providing for the inspection of meats for exportation, and prohibiting the importation of adulterated articles of food or drink, and authorizing the President to make proclamation in certain cases, and for other purposes" (26 Stat., 414); of the act of Congress approved February 2, 1903, entitled "An act to enable the Secretary of Agriculture to more effectually suppress and prevent the spread of contagious and infectious diseases of live stock, and for other purposes" (32 Stat., 791), and of the act of Congress approved March 4, 1911, entitled "An act making appropriations for the Department of Agriculture for the fiscal year ending June thirtieth, nineteen hundred and twelve" (Public, No. 478), the following regulations, which for the purpose of identification are designated as B. A. I. Order 180, are issued, superseding all previous regulations on the same subject, and shall become and be effective at once.

JAMES WILSON, *Secretary.*

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### GENERAL PROVISIONS.

#### PORTS OF IMPORT AND QUARANTINE AND INSPECTION STATIONS.

*Regulation 1.*—With the approval of the Secretary of the Treasury, the following-named ports, subports, and customs stations are hereby designated as quarantine stations, and all horses, cattle, sheep, and other ruminants, and swine imported into the United States and which are subject to both quarantine and inspection must be entered through said stations, viz: On the Atlantic seaboard: Boston, Mass.; New York, N. Y.; and Baltimore, Md. On the Pacific seaboard: San Francisco and San Diego, Cal., and Port Townsend, Wash. Along the boundary line between the United States and Mexico: Campo and Calexico, Cal.; Nogales, Ariz., El Paso, Eagle Pass, Laredo, Rio Grande City, Edinburgh, and Brownsville, Tex. Along the border or boundary line between the United States and Canada: Vanceboro, Houlton, Van Buren, and Fort Fairfield, Me.; also Lowelltown, Me. (port of Bangor, Me.), for a part of each year beginning August 15 and continuing during the months of September, October, and November (Aug. 15 to Nov. 30, inclusive); Beecher Falls, Island Pond, Newport, Richford, St. Albans, and East Alburg, Vt.; Rouses Point, Hogansburg, Massena, Ogdensburg, Cape Vincent, Clayton, Charlotte, Niagara Falls, and Buffalo, N. Y.; Detroit, Port Huron, and Sault Ste. Marie, Mich.; and Pembina, N. Dak.

The following-named stations are designated for the entry of animals which are subject to inspection, but not to quarantine, viz: Eastport and Calais, Me.; Derby Line, North Troy, Alburg, and Swanton, Vt.; Mooers Junction, Chateugay, Fort Covington, Malone, Waddington, Morristown, Lisbon, and Alexandria Bay, N. Y.; Blaine, Sumas, and Seattle, Wash.

#### DEFINITIONS OF TERMS.

*Regulation 2.*—Whenever in these regulations the following words, names, or terms are used they shall be construed as follows:

*Animals.*—This word refers particularly to horses, asses, mules, cattle, sheep, and other ruminants, swine, and collie, shepherd, or sheep dogs, but may include, when so ordered by the Chief of the Bureau of Animal Industry, any domestic or other kind of animal which may be offered for importation.

*Horses.*—This word refers to and includes horses, mules, and asses.

*Ruminants.*—This word refers to and includes all animals which chew the cud, or regurgitate a portion of their food for a second mastication before finally swallowing it, such as cattle, sheep, goats, deer, antelopes of all varieties, camels, dromedaries, alpacas, llamas, giraffes, and buffaloes of various kinds. The regulations applying to sheep will govern for all ruminants except cattle.

*Cattle.*—This word refers to the domestic animals of the bovine species, but shall include in addition the bisons and various kinds of buffaloes.

*Other ruminants* refers to all animals defined above under "Ruminants," except such as are embraced in the foregoing definition for "Cattle."

*Swine.*—The word "swine" refers to and includes the domestic hog, the wart hog, the water hog, and other varieties of wild hogs prized by owners of menageries and zoological collections.

*Contagious diseases.*—These words include and apply to all or any of the following diseases: Glanders and farcy, maladie du coît, distemper or strangles, epizootic lymphangitis, anthrax, contagious pleuro-pneumonia, Texas or splenetic fever, tuberculosis, foot-and-mouth disease, rinderpest, surra, variola, foot rot, scabies, hog cholera, swine plague, swine erysipelas, and other contagious or infectious diseases of cattle, sheep, or other ruminants, and swine.

*Cattle ticks.*—These words refer to the cattle ticks which are carriers of the infection of Texas, southern, or splenetic fever.

*Inspector.*—The word "inspector," unqualified, refers to the veterinary inspector of the Bureau of Animal Industry in charge of the quarantine station.

HORSES AND ACCOMPANYING FORAGE.

*Regulation 3.*—All horses imported into the United States from any part of the world except North America shall be required to pass a veterinary inspection at the port of entry by an inspector of the Bureau of Animal Industry. Such inspector shall not allow the landing of any hay, straw, or forage which accompanies shipments of horses from any country on the Continent of Europe until it has been disinfected as the inspector may prescribe. In case the inspector finds horses affected with any contagious disease he shall isolate them and immediately report the fact to the Chief of the Bureau of Animal Industry, who may refuse to allow the landing of horses so diseased. When horses imported from a country of continental Europe from which hay is permitted arrive in a healthy condition, and no diseased condition is discoverable, the hay, straw, and other forage from such country may remain on board the steamer and be returned. This forage may be used without disinfection in the feeding of animals exported on the same ship, provided it is accompanied by a certificate issued by the proper Government officer of such country, as required by the regulations of this department for the importation of hay and straw from continental Europe, and that there are no indications that it is infected; but if the forage is found to be infected the fact must be reported to the Chief of the Bureau of Animal Industry, who will direct the disposition to be made thereof.

CERTIFICATE FOR RUMINANTS.

*Regulation 4.*—All ruminants imported into the United States from any part of the world except North America shall be accompanied by a certificate from the local authority of the district in which the said animals have been continuously located for six months next preceding the date of shipment, stating that no contagious pleuro-pneumonia, foot-and-mouth disease, anthrax, rinderpest, or any other disease contagious to cattle, except tuberculosis and actinomycosis, has existed in said district for one year preceding.

RUMINANTS AND SWINE FROM THE NETHERLANDS AND BELGIUM.

*Regulation 5.*—Ruminants and swine from the Netherlands and Belgium will not be eligible for entry into the United States if shipped through or landed at any port in continental Europe outside of the Netherlands and Belgium. They should be shipped direct to the United States, or may be transshipped at an English port.

CERTIFICATE FOR SWINE.

*Regulation 6.*—All swine imported into the United States from any part of the world except North America shall be accompanied by a certificate similar to the one required for cattle, sheep, and other ruminants, but relating to the existence of foot-and-mouth disease, hog cholera, swine plague, and erysipelas.

AFFIDAVIT FOR RUMINANTS AND SWINE.

*Regulation 7.*—All ruminants and swine imported into the United States from any part of the world except North America shall also be accompanied by an affidavit of the owner stating that said animals have been continuously located in the district whence shipped for six months next preceding the date of shipment, that no contagious disease affecting the species of animals imported has existed among them nor among any animals of their kind with which they have come in contact for six months last past, and that no inoculation has been practiced among said animals during the preceding year; also by an affidavit from the importer or his agent supervising the shipment, stating that they have not passed through any district infected with contagious diseases affecting said kind of animals, that they have not been exposed in any possible manner to the contagion of any of said contagious diseases, and that the animals, when not driven, have been shipped in clean and disinfected cars and vessels direct from the farm where purchased.

PRESENTATION OF PAPERS TO COLLECTOR OF CUSTOMS.

*Regulation 8.*—The certificates and affidavits hereinabove required must accompany said animals and be presented to the collector of customs at the port of entry and be by him delivered to the inspector of the Bureau of Animal Industry stationed at said port, to allow the animals to be imported into the United States.

PERIOD OF QUARANTINE.

*Regulation 9.*—All cattle imported into the United States from any part of the world except North America, Great Britain, Ireland, and the Channel Islands shall be subject to a quarantine of 90 days, counting from the date of shipment, this date of shipment to be the date of clearance of the vessel bringing the animals to the United States. Sheep and other ruminants and swine from any part of the world except North America shall be subject to a quarantine of 15 days, counting from the date of arrival at the quarantine station: *Provided,* That cattle and sheep imported for immediate slaughter at the port of landing may be imported without quarantine, but shall be subject to such restrictions as the Chief of the Bureau of Animal Industry, after causing an inspection to be made, may consider necessary in each case for guarding the domestic animals of the United States from contagion: *Provided further,* That the period of quarantine for cattle imported from Great Britain, Ireland, and the Channel Islands shall be 30 days, counting from the date of arrival at the quarantine station.

TUBERCULIN TEST FOR CATTLE.

*Regulation 10.*—All cattle 6 months old or over imported from Great Britain, Ireland, the Channel Islands, the Netherlands (Holland), and Belgium directly into the United States, and which are subject to quarantine, shall be tested with tuberculin by an inspector of the Bureau of Animal Industry before being exported or after arrival at the animal quarantine station at the port of entry; and, when considered necessary, a subsequent tuberculin test of imported cattle shall be made during the last two weeks of their quarantine period. Cattle from countries not otherwise provided for shall be tested in the said quarantine stations. All cattle so tested which show a reaction shall be prohibited from entry into the United States, or be disposed of as provided in Regulation 16 of these regulations. Persons desiring animals tested abroad should address the inspector of the United States Bureau of Animal Industry, care of United States consul's office, Liverpool, England.

PERMITS FOR IMPORT ANIMALS.

*Regulation 11.*—Any person contemplating the importation of cattle, sheep, and other ruminants, and swine, from any part of the world except North America, must first obtain from the Secretary of Agriculture two permits, one stating the number and kind of animals to be imported, the port, and probable date of shipment, which will on presentation to the American consul at the said port of shipment entitle them to a clearance; the other, stating the port at which said animals are to be landed and quarantined, and the approximate date of their arrival, and this will assure the reception of the number and kind of animals specified therein at the port and quarantine station on the date prescribed for their arrival or at any time during three weeks immediately following, after which the permit will be void. These permits shall in no case be available at any port other than the one mentioned therein. Permits must be in the name of the owner of or agent for each separate lot of animals. Permits will be issued to quarantine at such port as the importer may elect, so far as facilities exist at such port, but in no case will permits for importation at any port be granted in excess of the accommodations of the Government quarantine station at such port.

PAPERS BY UNITED STATES CONSULS.

*Regulation 12.*—United States consuls should give clearance papers or certificates for animals from their districts intended for exportation to the United States only upon presentation of permits as above provided, with dates of probable arrival and destination corresponding with said permits, and in no case for a number in excess of that mentioned therein. When such shipments originate in the interior of a foreign country these permits should be submitted to the consul of that district, and through the forwarding agent to the consul at the port of embarkation.

COLLIE, SHEPHERD, OR SHEEP DOGS.

*Regulation 13.*—All dogs imported into the United States from any part of the world except North America shall be subject to inspection by an inspector of the Bureau of Animal Industry, and any such animal or animals, except the smaller breeds classed as house dogs, may, in the discretion of the inspector, be handled as herein prescribed for collie, shepherd, or sheep dogs.

All collie, shepherd, or sheep dogs from any foreign country, except the countries of North America, shall be subjected to quarantine for a period not to exceed two weeks, or until it can be determined by inspection or examination by an inspector of the Bureau of Animal Industry as to whether such dogs are the hosts of the tapeworm (*Tænia cœnurus*). In the event it is found by such inspection or examination that such animals are so infected, they must be medically treated under the supervision of an inspector of the bureau, and held in quarantine until it can be definitely determined that they are free from such infection or the infection of other communicable disease, before being allowed to be imported into the United States or to mingle with sheep or other live stock in the United States. The collector of customs at the port of entry will notify the inspector of the Bureau of Animal Industry of the arrival of any dog or dogs.

The ports of entry for collie, shepherd, or sheep dogs are limited to the ports designated in the regulations of this department for the entry of animals which are subject to both inspection and quarantine.

INSPECTION.

*Regulation 14.*—All animals imported into the United States and which are subject to inspection shall be carefully inspected by an inspector of the Bureau of Animal Industry, and all animals found to be free from disease and not to have been exposed to any contagious disease shall be admitted into the United States, subject to the provisions for quarantine, as required by Regulation 9, except as otherwise provided.

QUARANTINE RELEASE.

*Regulation 15.*—A release from quarantine will be given to each owner for the number and kind of animals belonging to him which are discharged from quarantine, and this release will be a certificate of fulfillment of quarantine regulations. In case an importation of animals is owned by more than one person a release will be issued to each owner or agent covering the animals which belong to him.

DISPOSAL OF DISEASED ANIMALS.

*Regulation 16.*—Whenever any animal on arrival at the port of entry or in the quarantine station is found to be affected with a contagious disease or to have been exposed to such disease said animal and all animals that have been in contact with or exposed to said animal shall either be refused landing or placed in special quarantine. All such animals found to be so diseased or exposed, either on arrival at port of entry or after being placed in quarantine, shall be at once reported by the inspector to the Chief of the Bureau of Animal Industry, who will direct whether or not said animal or animals shall be landed and quarantined, and as to whether or not said animal or animals shall be appraised and slaughtered, as provided by section 8 of the act approved August 30, 1890.

DISINFECTION OF VESSELS.

*Regulation 17.*—If a shipment of imported animals shall prove to be infected with or to have been exposed to the infection of disease, such portions of the cargo or the vessel on which they arrived as have been exposed to these animals or their emanations shall be subjected, under the direction of the inspector of the Bureau of Animal Industry, to disinfection in such manner as may be considered necessary by said inspector before the shipment can be landed. In all cases the parts of the vessel that have been occupied by imported animals shall be cleaned and disinfected with limewash under the supervision of the inspector of the port.

ARTICLES ACCOMPANYING ANIMALS.

*Regulation 18.*—No litter, fodder, or other aliment, nor any ropes, straps, chains, girths, blankets, poles, buckets, or other things used for or about the animals, and no manure shall be landed from any vessel excepting under such regulations as the inspector shall prescribe.

MOVEMENT FROM VESSEL TO QUARANTINE STATION.

*Regulation 19.*—On moving animals from the ocean steamer to the quarantine grounds they shall not be unnecessarily passed over any highways, but shall be placed on cars at the wharves or removed to the cars on a boat which is not used for conveying other animals. If such boat has carried animals within three months, it must be first cleaned and then disinfected under the supervision of the inspector, and after the conveyance of the imported animals the boat shall be disinfected in the same manner before it may be again used for the conveyance of animals. When passage upon or across the public highway is unavoidable in the transportation of animals from the place of landing to the quarantine grounds, it shall be under such careful supervision and restrictions as the inspector and the local authorities may direct.

SPECIAL PLATFORMS AND CHUTES.

*Regulation 20.*—Platforms and chutes used for loading and unloading imported animals shall be reserved for such animals or shall be cleaned and disinfected as above before being used for such imported animals.

SPECIAL CARS.

*Regulation 21.*—The railway cars used in the transportation of animals to the quarantine grounds shall be either cars reserved for this exclusive use or box cars not otherwise employed in the transportation of animals or their fresh products, and after each journey with animals to the quarantine grounds they shall be disinfected by thorough cleansing and disinfection under the direction of the inspector.

REQUIREMENTS AT QUARANTINE STATIONS.

ARRIVAL OF ANIMALS.

*Regulation 22.*—While animals are arriving at the quarantine stations or leaving them, all quarantined stock in the yards adjoining the alleyways through which they must pass shall be rigidly confined to their stables. Animals arriving by the same ship may be quarantined together in one yard and stable, but those coming on different ships shall in all cases be placed in separate yards.

GATES OF STATION.

*Regulation 23.*—The gates of the quarantine stations and of all yards of said stations shall be kept locked except when animals are entering or leaving quarantine.

ANIMAL ATTENDANTS.

*Regulation 24.*—The attendants on animals in particular yards are forbidden to enter other yards and buildings unless such are occupied by stock of the same shipment with those under their special care.

DOGS, CATS, ETC., PROHIBITED.

*Regulation 25.*—No dogs, cats, or other animals, except those necessarily present, shall be allowed in the quarantine grounds.

RECORD KEPT BY INSPECTOR.

*Regulation 26.*—The allotment of yards shall be under the direction of the inspector, who shall keep a register of animals entered, with description, name of owner, name of vessel in which imported, date of arrival and release, and other important particulars.

WATER; MANURE.

*Regulation 27.*—The inspector shall see that water is regularly furnished to the stock. Special places for depositing manure from yards and stables shall be provided, and no manure shall be removed from the quarantine station until the release of the animals producing the same.

DISPOSAL OF MILK.

*Regulation 28.*—Milk from quarantined animals shall not be used by any persons other than those in charge of such animals, nor fed to any other animals than those within the same lot, until the animals have been in quarantine 10 days.

FEED AND ATTENDANTS TO BE PROVIDED BY OWNER.

*Regulation 29.*—Feed and attendants shall be provided by the owners of stock quarantined, and each owner or his agent shall give satisfactory assurance to the inspector at the time of admission to quarantine that such provision will be made. The employees of such owners shall keep the sheds and yards clean to the satisfaction of the inspector and be subject to the rules at the station. If for any cause the owners of the quarantined stock refuse or neglect to supply feed and attendants, the inspector will furnish the same. The feed and care so furnished shall be at the expense of the owner of the stock and the charges therefor will be a lien on the animals. After the expiration of one-third of the quarantine period, if payment has not been made, the owners of the animals will be notified by the inspector that if said charges be not immediately paid, or satisfactory arrangements made for the payment, the inspector will sell the stock at public auction at the expiration of the period of quarantine to pay the expense of feed and care during that period. Notice of the sale will be published once a week for two weeks in a newspaper published in the county where the station is located. The day of sale will be after the expiration of the quarantine period, and the sale will be made at such place as may be designated by the inspector. From the proceeds of

the sale an amount equal to the charges for feed and care of the animals and the expense of the sale will be covered into the United States Treasury, and the remainder, if any, will be held for the owners, but if not called for at the end of six months from the date of sale this balance will be deposited in the United States Treasury.

SMOKING; VISITORS; PUBLIC SALES.

*Regulation 30.*—Smoking is strictly forbidden within any quarantine inclosure. No visitors shall be admitted to the quarantine station without special written permission from the inspector. Butchers, cattle dealers, and their employees are especially excluded. No public sale shall be allowed within quarantine grounds.

RECORD OF TEMPERATURES.

*Regulation 31.*—The inspector shall, in his daily rounds, so far as possible, take the temperature of each animal, beginning with the herds that have been longest in quarantine and ending with the most recent arrivals, and shall record such temperatures on lists kept for that purpose. In passing from one herd to another he shall invariably wash his thermometer and hands in a weak solution (1 to 40) of carbolic acid.

APPEARANCE OF DISEASE IN QUARANTINE.

*Regulation 32.*—If any disease diagnosed to be of a contagious nature shall appear the inspector shall notify the Chief of the Bureau of Animal Industry, who shall visit the station personally or send a veterinary inspector, and on the confirmation of the diagnosis the herd shall be disposed of according to the gravity of the affection. The yard and shed in which such disease shall have appeared shall be subjected to a thorough disinfection. Litter and fodder shall be burned. Yards, fences, sheds, utensils, and other appliances shall be disinfected as the Chief of the Bureau of Animal Industry may direct. The infected herd shall be rigidly confined to its stable or stables, where disinfectants shall be freely used, and the attendants shall be forbidden all intercourse with the attendants in other yards and with persons outside the quarantine grounds.

IMPORTATION OF PUREBRED ANIMALS FOR BREEDING PURPOSES.

*Regulation 33.*—Importers of animals which are subject to both inspection and quarantine, imported for breeding purposes and intended to be entered free of duty under the provisions of paragraph 492 of the tariff act of August 5, 1909 (36 Stat., 11, 72), will not be required to give the bond or stipulation for the production of registry certificates, provided for by the customs regulations, until the end of the quarantine period, in order that they may avail themselves of such period to procure from this department the required certificates of record and pedigree. Such animals will not, however, be released from quarantine except upon notice from the collector of customs that all requirements of the customs regulations relative to their entry have been complied with by the importer.

IMPORTATIONS FROM NORTH AMERICAN COUNTRIES.

CONSIGNMENTS FOR SLAUGHTER.

*Regulation 34.*—Animals admitted from North American countries for immediate slaughter shall be consigned to some recognized slaughtering center, and shall be slaughtered within two weeks from the date of entry. All animals admitted in bond for export shall be subject to inspection at the port of entry.

CANADA.

*Affidavit to accompany animals.*

*Regulation 35.*—All animals imported into the United States from the Dominion of Canada shall be accompanied by an affidavit made by the owner or importer, declaring clearly the purpose for which said animals are imported, viz, whether for breeding purposes, for milk production, for work, for grazing, feeding, or slaughter, or whether they form part of settler's effects, or whether they are horses entered for temporary stay, as provided by Regulation 36. Said affidavit shall be presented to the collector of customs at the port of entry, who will decide whether the animals are entitled to entry under these regulations, and who will notify the inspector of the Bureau of Animal Industry in all cases where the regulations require an inspection to be made.

*Horses.*

*Regulation 36.*—Horses for breeding, racing, show, and sale purposes, for grazing, or for work, shall be inspected at the port of entry, and when so ordered by the Chief of the Bureau of Animal Industry must be accompanied by a satisfactory certificate of mallein test signed by an official Canadian veterinarian or by an inspector of the Bureau

of Animal Industry. Those belonging to Indian tribes and settlers or immigrants and those used in connection with stock raising (cow ponies) or mining, and those for temporary stay at points along the frontier not exceeding two weeks, whether for pleasure, driving, or teaming, shall be required to pass a veterinary inspection at the port of entry by an inspector of the Bureau of Animal Industry; or they may be admitted without inspection upon written permission from the Secretary of Agriculture first had and obtained: *Provided, however,* That neither inspection by an inspector of the Bureau of Animal Industry nor written permission from the Secretary of Agriculture shall be required for Canadian horses for pleasure, driving, or teaming, whether driven or ridden into the United States for a temporary stay not to exceed three days. The same rule will apply to American horses returning to the United States from Canada after a stay in Canada not to exceed three days. Horses admitted in bond for export from the United States shall be subject to inspection at any point at which this department has inspectors stationed.

*Cattle.*

*Regulation 37.*—Cattle for breeding purposes, milk production, grazing, or feeding must be inspected and must be accompanied by a certificate signed by a Canadian official veterinarian stating that no contagious disease affecting cattle except tuberculosis and actinomycosis, has existed in the district in which the animals have been kept for six months preceding the date of importation. The owner must present an affidavit that said certificate covers the cattle in question.

*Tuberculin test for cattle.*

*Regulation 38.*—Cattle over 6 months old for breeding purposes and milch cows shall also be accompanied by a satisfactory certificate of tuberculin test (which test shall have been made within 30 days of the date of importation by a veterinarian in the employ of and receiving a salary from the Canadian Government, or by an inspector of the Bureau of Animal Industry), giving the date and place of testing and a description of the cattle, with age and markings.

*Cattle for exhibition purposes.*

*Regulation 39.*—The Chief of the Bureau of Animal Industry may, however, by written order, waive the foregoing tuberculin-test requirement for cattle which are to be imported temporarily for exhibition purposes, provided such cattle are accompanied by a satisfactory certificate of tuberculin test by a veterinarian in the employ of and receiving a salary from the Canadian Government made not more than six months previously and an affidavit by the owner or importer stating that the said certificate of tuberculin test refers to the cattle in question. Any such cattle which are not sold to remain in the United States shall be returned immediately to Canada at the close of the exhibition. The department must be notified of any Canadian cattle which will remain in the United States, not tested as required by Regulation 38, and the tuberculin test will be applied to them by an inspector of this department before shipment to destination. All cattle, sheep, and swine intended for exhibition purposes must be shipped directly to the exhibition grounds and must not be unloaded in any public stockyards.

*Cattle quarantine.*

*Regulation 40.*—All cattle imported for breeding, milk production, grazing, or feeding, when not accompanied by the required affidavit or certificates, must be detained in quarantine for one week at the expense of the owner or importer under the supervision of the inspector. During this detention a rigid inspection will be made and cattle for breeding or milk production which are over 6 months old will be tested with tuberculin. Animals found free from disease at the end of that period will be released.

*Inspection of cattle.*

*Regulation 41.*—Cattle for slaughter shall be inspected. Those forming part of settlers' effects or belonging to Indian tribes may be admitted through any port without inspection or certification upon written permission of the Secretary of Agriculture first had and obtained. Cattle in bond for export may be admitted without inspection at any of the ports named in Regulation 1 in transit to and for export from Portland, Me., Boston, Mass., New York, N. Y., Philadelphia, Pa., Baltimore, Md., and Newport News and Norfolk, Va., subject to inspection at the port of export: *Provided,* That inspection may be required by the Secretary of Agriculture whenever, in his opinion, such inspection is necessary.

*Sheep.*

*Regulation 42.*—All sheep imported into the United States from Canada for breeding, grazing, or feeding must be inspected at the port of entry by an inspector of the Bureau

of Animal Industry. They must also have been inspected by a veterinarian in the employ of and receiving a salary from the Canadian Government, and be accompanied by a certificate signed by him stating that he has inspected the sheep and found them free from disease, and that no contagious disease affecting sheep has existed in the district in which the animals have been kept for six months preceding the date of importation, stating also that they have been twice carefully dipped under his personal supervision, or under the personal supervision of another veterinarian in the employ of and receiving a salary from the Canadian Government, in one of the dips approved by the Secretary of Agriculture, as described in Regulation 33 of B. A. I. Order 143 as amended [reprinted at the end of this order]. The owner or importer shall present an affidavit that said certificate refers to the sheep in question: *It is provided further,* That any such sheep which are unaccompanied by the aforesaid certificate showing that they have been twice dipped, as herein prescribed, shall be subjected to a quarantine of 30 days.

*Sheep for slaughter, export, etc.*

*Regulation 43.*—Sheep for immediate slaughter and those belonging to Indian tribes or forming part of settlers' effects will be admitted at any port without inspection when accompanied by a certificate of an official veterinarian showing freedom from disease. Sheep in bond for export will be admitted without inspection when accompanied by such certificate at any of the ports mentioned in Regulation 1 in transit to and for export from Portland, Me., Boston, Mass., New York, N. Y., Philadelphia, Pa., Baltimore Md., and Newport News and Norfolk, Va., subject to inspection at the port of export.

*Other ruminants.*

*Regulation 44.*—Ruminants other than cattle and sheep shall be accompanied by affidavits similar to those required for cattle, and when not accompanied by said affidavits, relating to the kind of animals offered for importation, they shall be detained in quarantine one week, or for such period as may be necessary to determine whether or not they are free from disease.

*Swine.*

*Regulation 45.*—All swine shall be subject to inspection and shall be accompanied by a certificate signed by a Canadian official veterinarian stating that no swine plague or hog cholera has existed within a radius of 5 miles of the premises in which they have been kept for a period of six months immediately preceding the date of shipment. The owner or importer must present an affidavit that the said certificate covers the swine in question. Swine not accompanied by affidavit and certificate will be subject to a quarantine of two weeks at the expense of the owner or importer, under the supervision of the inspector.

*Cars to be cleaned and disinfected.*

*Regulation 46.*—The railroad cars used in the transportation of animals specified by these regulations must be thoroughly cleaned and disinfected before such animals are placed therein. All litter from previous shipments must be removed and the car cleaned and whitewashed with the following disinfectant:

To make 5 gallons of disinfectant proceed as follows: Slake 7½ pounds of lime, using hot water if necessary to start action. Make to a cream with water. Stir in 20 fluid ounces of cresol (commercially known as carbolic acid, liquid) at least 95 per cent pure and make up to 5 gallons. Stir thoroughly. If to be applied through a spray nozzle, strain through a wire sieve. Stir frequently when applying, and keep covered when not in use.

The interior of the car must be completely covered with this mixture, a sufficient quantity being applied to saturate the woodwork thoroughly.

Unless this regulation is complied with, Canadian animals will not be allowed entry into the United States, and animals from the United States will not be admitted into Canada. The shipper should see that the cars are properly cleaned and disinfected before animals are loaded.

MEXICO.

*Horses.*

*Regulation 47.*—All horses infested with ticks are prohibited from entering the United States from the Republic of Mexico, when destined to an area in the United States from which cattle are excluded by the Federal, State, or Territorial authorities on account of ticks, unless and until such tick-infested horses are first dipped or otherwise treated as hereinafter specified in this regulation.

Horses that can be handled and inspected for ticks shall be so inspected at the port of entry. The importation of unbroken horses (i. e., those which are not gentle and are

not broken for saddle, harness, or work), destined to an area from which cattle are excluded by the Federal, State, or Territorial authorities on account of ticks, is prohibited unless the horses are first dipped as hereinafter specified in this regulation for tick-infested horses. However, if horses intended for importation into the United States are held for six months immediately preceding the date they are offered for importation, on premises known to be free from ticks, they may be admitted for any destination without dipping. Horses belonging to Indian tribes and settlers and those used in stock raising (cow ponies) or mining, and those for temporary stay at points along the frontier not to exceed two weeks, whether for pleasure, driving, or teaming, may be admitted into the United States without inspection, provided they are not entered, moved, or permitted to enter into any portion of any State or Territory into which the movement of cattle is prohibited by the Federal, State, or Territorial authorities on account of ticks.

The dipping required for tick-infested horses shall be done in Beaumont crude petroleum or standard arsenical solution, or the horses shall be otherwise treated in a manner approved by the Secretary of Agriculture.

Horses admitted in bond for export from the United States shall be subject to inspection at any point at which the department has inspectors stationed.

*Standard arsenical solution.*—In preparing each 500 gallons of the standard arsenical solution there shall be used 10 pounds of finely powdered white arsenic, containing not less than 99 per cent of arsenic trioxid, 25 pounds of sal soda, and 1 gallon of pine tar. The arsenic and sal soda shall be boiled together in not less than 25 gallons of water for 15 minutes, or longer if necessary, to effect complete solution of the arsenic. Before the pine tar is added the temperature of the solution shall be reduced to 140° F. This may be done by the addition of cold water. The pine tar shall then be added in a small stream while the solution is thoroughly stirred, after which the solution shall be immediately diluted with clear water sufficient to make 500 gallons of dip.

### *Cattle.*

*Regulation 48.*—All cattle imported into the United States from the Republic of Mexico must be inspected at the port of entry by an inspector of the Bureau of Animal Industry, and found free from disease. No cattle shall be imported for any purpose from any district or area infested with cattle ticks into a tick-free area of the United States. Cattle for breeding purposes, milk production, grazing, or feeding imported into a tick-free area of the United States shall be accompanied by an affidavit made by the owner stating that such cattle have been in the district from which shipped for six months next preceding the date of importation, and that no contagious, infectious, or communicable disease has existed among them for six months last past, and that no cattle ticks have been found on such cattle or any animals with which they have come in contact for at least 60 days last past; also they shall be accompanied by an affidavit made by the importer, or his agent supervising the shipment, stating that such cattle while en route to the port of entry have not passed through any district or area infested with southern, Texas, or splenetic fever, or any other contagious, infectious, or communicable disease affecting cattle, and that they have not been driven on foot through any district or area infested with cattle ticks, and if transported by rail or water, that they have been shipped in clean and disinfected cars or vessels, and, in any event, that they have not been exposed en route from the point of origin to infection of southern, Texas, or splenetic fever, or any contagious, infectious, or communicable disease affecting cattle, or to cattle ticks, in any manner whatsoever.

*Regulation 49.*[1]—All tick-infested cattle offered for importation from the Republic of Mexico into that part of Texas below the southern cattle-quarantine line shall be imported only through the following ports: Eagle Pass, Laredo, Brownsville, Galveston, Port Arthur, and Texas City, and be accompanied by an affidavit of the owner, stating that such cattle have been in the district from which shipped for six months next preceding the date of importation; that no contagious, infectious, or communicable disease has existed among them or among any animals with which they have come in contact for six months last past, except the so-called Texas or splenetic fever; also, by affidavit of the importer, or his agent supervising the shipment, stating that the cattle have not passed through any district infected with contagious diseases affecting animals of their kind, except the so-called Texas or splenetic fever; that they have not been exposed in any possible manner to the contagion of any contagious disease, except the so-called Texas or splenetic fever; and that the animals, when not driven, have been shipped in cars and vessels which have been cleaned and disinfected except as to ticks. When such cattle are not accompanied by the affidavits hereinbefore described they shall be detained in quarantine at the port of entry at the expense of the owner or

[1] This regulation was issued jointly by the Secretary of the Treasury and the Secretary of Agriculture on Mar. 9, 1911, under authority of the agricultural appropriation act of Mar. 4, 1911 (Public, No. 478), and is here reprinted for convenience of reference.

importer, under the supervision of the inspector, for such period as may be necessary to determine whether or not such cattle are entitled to entry under the regulations of and in the discretion of the Secretary of Agriculture. During this detention in quarantine a rigid inspection by an inspector of the Bureau of Animal Industry of the Department of Agriculture shall be made, including the tuberculin test if deemed necessary. All such cattle when entered shall be subject to the regulations governing the handling and transportation of cattle from the districts infected with southern, Texas, or splenetic fever.

*Sheep.*

*Regulation 50.*—Sheep for breeding purposes, grazing, feeding, or for slaughter will be admitted if found upon inspection by an inspector of the United States Bureau of Animal Industry to be free from scabies or other contagious diseases and are accompanied by an affidavit made by the owner stating that they have been in the district from which shipped for six months next preceding the date of importation and that no contagious disease affecting sheep has existed among them, nor among other sheep with which they have come in contact, for six months last past; also by an affidavit made by the importer, or his agent supervising the shipment, stating that they have not passed through any district infected with contagious diseases affecting sheep, and that they have not been exposed in any possible manner to the contagion of any contagious disease, and that the animals, if not driven, have been shipped in cleaned and disinfected cars and vessels direct from the farm or ranch where purchased. But such sheep shall, nevertheless, be dipped twice, 10 days apart, at the expense of the owner, as prescribed by the rules and regulations of the Secretary of Agriculture (reprinted at end of this order), before being permitted to proceed to their destination in the United States or to mingle with other sheep. Sheep unaccompanied by the required affidavits must be detained in quarantine for one week, or as long as may be required, at the expense of the owner or importer, under the supervision of the inspector, and twice dipped as provided herein.

*Swine and ruminants other than cattle and sheep.*

*Regulation 51.*—All swine and all ruminants other than cattle and sheep shall be accompanied by affidavits similar to those required for cattle and sheep relating to the existence of contagious disease affecting the kind of animals offered for importation, and when not accompanied by said affidavits shall be detained in quarantine for one week, as provided for cattle and sheep.

*Animals in bond.*

*Regulation 52.*—Animals in bond to Canada entering and passing through United States territory will be subject to inspection at the port of entry, or at any point en route, by an inspector of the Bureau of Animal Industry, and if found diseased, or to have been exposed to the contagion of disease, shall be dealt with as the Secretary of Agriculture may direct, depending upon the nature of the disease, as provided by these regulations for the particular kind of animal or animals so affected or exposed.

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DESCRIPTION OF SHEEP DIPS REFERRED TO IN REGULATION 42.

[Extract from B. A. I. Order 143.]

*Regulation 83.*—The dips now approved are:

(*a*) The tobacco dip, prepared from tobacco or from suitable tobacco products containing nicotine so as to produce a dipping bath which shall contain not less than seven one-hundredths of 1 per cent of nicotine.

(*b*) The lime-and-sulphur dip, made by mixing 8 pounds of unslaked lime and 24 pounds of flowers of sulphur and boiling with 30 gallons of water for not less than two hours. All sediment should be allowed to subside before the liquid is placed in the dipping vat. This liquid should be diluted sufficiently to make 100 gallons before use.

And, pending further investigation, the following-described dips:

(*c*) The cresol dip, which consists of a mixture of cresylic acid[1] with soap. When diluted ready for use this dip should contain one-half of 1 per cent of cresylic acid.

(*d*) The coal-tar creosote dip, which is made by mixing coal-tar creosote or coal-tar oils and cresylic acid separately with resin soap in varying proportions. This dip should contain when diluted ready for use not less than 1 per cent by weight of coal-tar oils and cresylic acid. In no case should the diluted dip contain more than four-tenths of 1 per cent nor less than one-tenth of 1 per cent of cresylic acid; but when the proportion of cresylic acid falls below two-tenths of 1 per cent the coal-tar oils should be

[1] By the term cresylic acid as used in these regulations is meant cresols and other phenols derived from coal tar, none of which boils below 185° C. nor above 250° C.

increased sufficiently to bring the total of the tar oils and the cresylic acid in the diluted dip up to 1.2 per cent by weight.

The cresol dip and the coal-tar creosote dip should always be tested on a small scale with the water and under the conditions to be employed in dipping, in order to avoid possible injury to stock. The diluted sample should be allowed to stand for at least an hour. If after this length of time there is a separation of an oily layer, the dip should not be used with that kind of water. Especial care in this connection is necessary where hard water is to be used.

In the undiluted coal-tar creosote dips there may be, in cold weather especially, a separation of naphthalene and other constituents of the dip. Care should therefore be taken to see that the concentrated dip is homogeneous in character before using any portion of it.

Manufacturers who desire the department to approve their dips for official dipping should submit a sample of their product to the Bureau of Animal Industry in Washington and accompany this with the formula used in preparing the dip.

Before a proprietary substance is approved for use in official dipping the manufacturer must agree as follows:

(1) To recommend for sheep scab a dilution of the product, so as to conform to the requirements of the Department of Agriculture.

(2) To maintain said product at a uniform composition.

(3) To place on packages of dips which have been examined and found to conform to the requirements of the department the following statement:

"A sample of this product has been submitted to the United States Department of Agriculture for examination. We guarantee the contents of this package to be of the same composition as the sample submitted to the department, and that when diluted according to the directions printed thereon for the treatment of sheep scab it will give a dipping fluid of the composition required of a ————[1] dip by the regulations of the Secretary of Agriculture governing sheep scab."

(4) To have on containers or advertising matter no reference to the United States Government or any of its departments except as provided in the preceding paragraph, unless such reference has been submitted to and approved by the Department of Agriculture, and to have on containers or advertising matter no false or misleading statement.

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LAWS UNDER WHICH THE FOREGOING REGULATIONS ARE MADE.

Extracts from an act of Congress entitled "An act providing for an inspection of meats for exportation, prohibiting the importation of adulterated articles of food or drink, and authorizing the President to make proclamation in certain cases, and for other purposes." Approved August 30, 1890. (26 Stat. L., 416.)

SEC. 6. That the importation of neat cattle, sheep, and other ruminants, and swine, which are diseased or infected with any disease, or which shall have been exposed to such infection within 60 days next before their exportation, is hereby prohibited; and any person who shall knowingly violate the foregoing provision shall be deemed guilty of a misdemeanor, and shall, on conviction, be punished by a fine not exceeding $5,000, or by imprisonment not exceeding three years, and any vessel or vehicle used in such unlawful importation with the knowledge of the master or owner of said vessel or vehicle that such importation is diseased or has been exposed to infection as herein described, shall be forfeited to the United States.

SEC. 7. That the Secretary of Agriculture be, and is hereby, authorized, at the expense of the owner, to place and retain in quarantine all neat cattle, sheep, and other ruminants, and all swine, imported into the United States, at such ports as he may designate for such purposes, and under such conditions as he may by regulation prescribe, respectively, for the several classes of animals above described; and for this purpose he may have and maintain possession of all lands, buildings, tools, fixtures, and appurtenances now in use for the quarantine of neat cattle, and hereafter purchase, construct, or rent as may be necessary, and he may appoint veterinary surgeons, inspectors, officers, and employees by him deemed necessary to maintain such quarantine, and provide for the execution of the other provisions of this act.

SEC. 8. That the importation of all animals described in this act into any port in the United States, except such as may be designated by the Secretary of Agriculture, with the approval of the Secretary of the Treasury, as quarantine stations, is hereby prohibited; and the Secretary of Agriculture may cause to be slaughtered such of the animals named in this act as may be, under regulations prescribed by him, adjudged to be infected with any contagious disease, or to have been exposed to infection so as to be dangerous

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[1] There should be inserted here the name of the class of dips to which the product belongs, such as "cresol" or "lime and sulphur," etc.

to other animals; and that the value of animals so slaughtered as being so exposed to infection, but not infected, may be ascertained by the agreement of the Secretary of Agriculture and owners thereof, if practicable; otherwise, by the appraisal by two persons familiar with the character and value of such property, to be appointed by the Secretary of Agriculture, whose decision, if they agree, shall be final; otherwise the Secretary of Agriculture shall decide between them, and his decision shall be final; and the amount of the value thus ascertained shall be paid to the owner thereof out of money in the Treasury appropriated for the use of the Bureau of Animal Industry; but no payment shall be made for any animal imported in violation of the provisions of this act. If any animals, subject to quarantine according to the provisions of this act, are brought into any port of the United States where no quarantine station is established, the collector of such port shall require the same to be conveyed by the vessel on which they are imported or are found to the nearest quarantine station at the expense of the owner.

SEC. 10. That the Secretary of Agriculture shall cause careful inspection to be made by a suitable officer of all imported animals described in this act to ascertain whether such animals are infected with contagious diseases or have been exposed to infection so as to be dangerous to other animals, which shall then either be placed in quarantine or dealt with according to the regulations of the Secretary of Agriculture; and all food, litter, manure, clothing, utensils, and other appliances that have been so related to such animals on board ship as to be judged liable to convey infection shall be dealt with according to the regulations of the Secretary of Agriculture; and the Secretary of Agriculture may cause inspection to be made of all animals described in this act intended for exportation, and provide for the disinfection of all vessels engaged in the transportation thereof, and of all barges or other vessels used in the conveyance of such animals intended for export to the ocean steamer or other vessels, and of all head ropes and other appliances used in exportation, by such orders and regulations as he may prescribe; and if, upon such inspection, any such animals shall be adjudged under the regulations of the Secretary of Agriculture to be infected or to have been exposed to infection so as to be dangerous to other animals, they shall not be allowed to be placed upon any vessel for exportation; the expense of all inspection and disinfection provided for in this section to be borne by the owner of the vessels on which such animals are exported.

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An act to enable the Secretary of Agriculture to more effectually suppress and prevent the spread of contagious and infectious diseases of live stock, and for other purposes. Approved February 2, 1903. (32 Stat. L., 791.)

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That in order to enable the Secretary of Agriculture to effectually suppress and extirpate contagious pleuro-pneumonia, foot-and-mouth disease, and other dangerous, contagious, infectious, and communicable diseases in cattle and other live stock, and to prevent the spread of such diseases, the powers conferred on the Secretary of the Treasury by sections four and five of an act entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," approved May twenty-ninth, eighteen hundred and eighty-four (Twenty-third United States Statutes, page thirty-one), are hereby conferred on the Secretary of Agriculture, to be exercised exclusively by him. He is hereby authorized and directed, from time to time, to establish such rules and regulations concerning the exportation and transportation of live stock from any place within the United States where he may have reason to believe such diseases may exist into and through any State or Territory, including the Indian Territory, and into and through the District of Columbia and to foreign countries, as he may deem necessary, and all such rules and regulations shall have the force of law. Whenever any inspector or assistant inspector of the Bureau of Animal Industry shall issue a certificate showing that such officer had inspected any cattle or other live stock which were about to be shipped, driven, or transported from such locality to another, as above stated, and had found them free from Texas, or splenetic, fever infection, pleuro-pneumonia, foot-and-mouth disease, or any other infectious, contagious, or communicable disease, such animals so inspected and certified may be shipped, driven, or transported from such place into and through any State or Territory, including the Indian Territory, and into and through the District of Columbia, or they may be exported from the United States without further inspection or the exaction of fees of any kind, except such as may at any time be ordered or exacted by the Secretary of Agriculture; and all such animals shall at all times be under the control and supervision of the Bureau of Animal Industry of the Agricultural Department for the purposes of such inspection.

SEC. 2. That the Secretary of Agriculture shall have authority to make such regulations and take such measures as he may deem proper to prevent the introduction or dissemination of the contagion of any contagious, infectious, or communicable disease of animals from a foreign country into the United States or from one State or Territory of the United States or the District of Columbia to another, and to seize, quarantine, and dispose of any hay, straw, forage, or similar material, or any meats, hides, or other animal products coming from an infected foreign country to the United States, or from one State or Territory or the District of Columbia in transit to another State or Territory or the District of Columbia whenever in his judgment such action is advisable in order to guard against the introduction or spread of such contagion.

SEC. 3. That any person, company, or corporation knowingly violating the provisions of this act or the orders or regulations made in pursuance thereof shall be guilty of a misdemeanor, and on conviction shall be punished by a fine of not less than one hundred dollars nor more than one thousand dollars, or by imprisonment not more than one year, or by both such fine and imprisonment."

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Extract from "An act making appropriations for the Department of Agriculture for the fiscal year ending June thirtieth, nineteen hundred and twelve." Approved March 4, 1911. (Public, No. 478.)

The act of August thirtieth, eighteen hundred and ninety, is hereby amended so as to authorize the Secretary of Agriculture, within his discretion, and under such joint regulations as may be prescribed by the Secretary of Agriculture and the Secretary of the Treasury, to permit the admission of tick-infested cattle from Mexico into that part of Texas below the southern cattle quarantine line.

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B. A. I. ORDER 181.

## Rule 9.—Revoking the Quarantine to Prevent the Spread of Lip-and-Leg Ulceration (Necrobacillosis) in Sheep (Effective on and After August 10, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

The fact has been determined by the Secretary of Agriculture, and notice is hereby given, that the contagious and communicable disease known as lip-and-leg ulceration (*necrobacillosis*) in sheep, which formerly existed in portions of the State of Wyoming, has been practically eradicated, and now exists to a slight extent only among sheep in the counties of Weston, Crook, Converse, and Natrona in Wyoming.

Now, therefore, I, JAMES WILSON, SECRETARY OF AGRICULTURE, under authority of law, do hereby remove and revoke the quarantine placed upon certain areas within the State of Wyoming by Rule 8, Revision 2, dated July 22, 1910, effective on and after August 1, 1910, Amendment 1, dated October 10, 1910, effective on and after October 17, 1910, and Amendment 2, dated December 19, 1910, effective on and after January 16, 1911.

Bureau of Animal Industry Order 169, being Rule 8, Revision 2, and all amendments thereto are hereby revoked.

The effect of this Rule 9 is to remove and revoke the subsisting quarantine for lip-and-leg ulceration (*necrobacillosis*) in sheep heretofore in effect in the United States.

This rule is in effect on and after August 10, 1911.

Done at Washington this 20th day of July, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

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B. A. I. ORDER 182.

## Special Order Modifying the Tuberculin-Test Requirement for Canadian Cattle Imported Temporarily for Exhibition Purposes at the Fair to be Held at Ogdensburg, N. Y.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
*Washington, D. C., August 21, 1911.*

Under authority conferred upon the Chief of the Bureau of Animal Industry by Regulation 39 of Bureau of Animal Industry Order 180, regulations for the inspection and quarantine of horses, cattle, sheep, swine, and other animals imported into the United

States, the requirements of Regulation 38 of Order 180 are hereby waived for cattle to be imported from Canada temporarily for exhibition purposes at the fair to be held at Ogdensburg, N. Y., from September 18 to 23, 1911:

*Provided*, That the provisions of said Regulation 39 shall be strictly applied to such cattle. Said Regulation 39 reads as follows:

REGULATION 39. The Chief of the Bureau of Animal Industry may, however, by written order, waive the foregoing tuberculin-test requirement for cattle which are to be imported temporarily for exhibition purposes, provided such cattle are accompanied by a satisfactory certificate of tuberculin test by a veterinarian in the employ of and receiving a salary from the Canadian Government made not more than six months previously, and an affidavit by the owner or importer stating that the said certificate of tuberculin test refers to the cattle in question. Any such cattle which are not sold to remain in the United States shall be returned immediately to Canada at the close of the exhibition. The department must be notified of any Canadian cattle which will remain in the United States, not tested as required by Regulation 38, and the tuberculin test will be applied to them by an inspector of this department before shipment to destination. All cattle, sheep, and swine intended for exhibition purposes must be shipped directly to the exhibition grounds and must not be unloaded in any public stock yards.

A. M. FARRINGTON,
*Acting Chief of the Bureau of Animal Industry.*

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B. A. I. ORDER 183.

## Rule 1, Revision 8.—To Prevent the Spread of Splenetic, Southern, or Texas Fever in Cattle (Effective on and after November 1, 1911).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.

The fact has been determined by the Secretary of Agriculture, and notice is hereby given, that a contagious and infectious disease, known as splenetic, southern, or Texas fever, exists among cattle in the following-named States, to wit:

CALIFORNIA, OKLAHOMA, TEXAS, MISSOURI, ARKANSAS, LOUISIANA, MISSISSIPPI, TENNESSEE, ALABAMA, VIRGINIA, NORTH CAROLINA, SOUTH CAROLINA, GEORGIA, and FLORIDA.

Now, therefore, I, James Wilson, Secretary of Agriculture, under authority conferred by section 1 of the act of Congress approved March 3, 1905 (33 Stat., 1264), do hereby quarantine the area hereinafter described, and do order by this Rule 1, Revision 8, under the authority and discretion conferred on the Secretary of Agriculture by section 3 of the act of Congress approved March 3, 1905 (33 Stat., 1265), that the interstate movement of cattle of the area herein quarantined to any point not located in the said quarantined area shall be made only in accordance with the regulations of the Secretary of Agriculture, designated as B. A. I. Order 143, promulgated March 22, 1907, and effective April 15, 1907, and amendments thereto, subject only to the exceptions hereinafter contained.

The following areas are quarantined for splenetic, southern, or Texas fever in cattle:

CALIFORNIA.

The counties of San Diego, Orange, and that part of San Luis Obispo County located south and west of a line beginning at the point of the intersection of the township line between township 32 south, range 17 east, and township 32 south, range 18 east, with the Santa Maria River on the southern boundary of the county of San Luis Obispo, and extending northerly on said township line between township 32 south, range 17 east, and township 32 south, range 18 east, and on township line between township 31 south, range 17 east, and township 31 south, range 18 east, to its intersection with the summit of the Santa Lucia range of mountains; thence following the summit of the Santa Lucia range of mountains northwesterly to its intersection with the northern boundary line of San Luis Obispo County.

During the continuance of this quarantine no cattle of the area hereinbefore described shall be moved or allowed to move except as provided for immediate slaughter to any point in the United States not in the State of California which is located in an area not quarantined for splenetic, southern, or Texas fever unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months, and unless and until the cattle shall have been inspected and found free of infection and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped.

TEXAS.

The entire State of Texas is quarantined with the exception of the counties of Dallam, Sherman, Hansford, Ochiltree, Lipscomb, Hartley, Moore, Hutchinson, Roberts, Hemp-

hill, Oldham, Potter, Carson, Gray, Wheeler, Deaf Smith, Randall, Armstrong, Donley, Collingsworth, Parmer, Castro, Swisher, Briscoe, Hall, Childress, Bailey, Lamb, Hale, Floyd, Motley, Cottle, Cochran, Hockley, Lubbock, Crosby, Dickens, Yoakum, Terry, Lynn, Garza, Kent, Gaines, Dawson, Andrews, Martin, El Paso, Jeff Davis, Presidio, Brewster, Reeves, Loving, Winkler, Ector, Midland, Ward, Scurry, Borden, Glasscock, Crane, and Upton; that part of Hardeman County north of the Fort Worth & Denver City Railway; those parts of Howard and Mitchell Counties north of the Texas & Pacific Railway; and those parts of the counties of Pecos and Terrell north and west of a line beginning at the southwest corner of Terrell County; thence in a northerly direction to the northwest corner of section No. 63, block D10, Texas Central Railway Co.; thence north along the western boundary of sections Nos. 64, 65, 66, 67, 68, 69, 70, 71, and 72 of said block D10 to the northwest corner of said section No. 72; thence continuing north through the western parts of sections Nos. 36, 25, 24, 13, 12, and 1, block 150, Texas & St. Louis Railroad Co., to the roadbed of the Galveston, Harrisburg & San Antonio Railroad Co.; thence southeasterly, following the roadbed of the said Galveston, Harrisburg & San Antonio Railroad Co., to a point on section No. 36, block A2, Galveston, Harrisburg & San Antonio Railroad Co.; thence north with the pasture fence through the eastern part of sections Nos. 36, 13, and 12 of said block A2 and across section No. 1, Gulf, Colorado & Santa Fe Railroad Co.; thence continuing north with said pasture fence through the eastern part of sections Nos. 16, 17, 46, 47, 76, 77, 106, 107, 136, 137, 142, 143, and 194, block D, Missouri, Kansas & Texas Extension Railway Co.; thence continuing in a northerly direction to a point on the northern boundary of section No. 6, block 160, Gulf, Colorado & Santa Fe Railroad Co., same being corner of pasture fence; thence east along the northern boundary of sections Nos. 6, 9, 10, 11, 12, 15, and 16, block 160, Gulf, Colorado & Santa Fe Railway Co., to the northeast corner of said section No. 16, the same being corner of pasture fence; thence in a northerly direction with the eastern boundary of sections Nos. 22, 21, 20, 23, 24, 25, 26, 27, 28, 29, 30, 31, and 32, block 1, Corpus Christi, San Diego & Rio Grande Narrow Gauge Railway Co., to the northeast corner of said section No. 32; thence west with the northern boundary of sections Nos. 32 and 33, same block, to the northwest corner of section No. 33, block 1, Corpus Christi, San Diego & Rio Grande Narrow Gauge Railway Co., corner of fence; thence north with the eastern boundary of sections Nos. 1, 12, 13, 24, 25, 36, 37, 48, 49, 60, 61, and 72, block 2, Corpus Christi, San Diego & Rio Grande Railway Co., to the northeast corner of said section No. 72; thence in an easterly direction with the pasture fence to the southeast corner of section No. 9, patented to James E. Evans; thence north along the eastern boundary of said section No. 9 to the northwest corner of section No. 100, block A2, Texas Central Railway Co.; thence east with the northern boundary of sections Nos. 100 and 89, same block, to the northeast corner of said section No. 89, block A2, Texas Central Railway Co.; thence north along the eastern boundary of sections Nos. 90, 91, 92, and 93 to the southeast corner of section No. 94, block A2, Texas Central Railway Co.; thence northwest diagonally across section No. 94 to the northwest corner of said section; thence continuing in a northwesterly direction diagonally across sections Nos. 14, 18, and 28 to the northeast corner of section No. 29, block C4, Gulf, Colorado & Santa Fe Railway Co.; thence west with the northern boundary of said section No. 29 to the northwest corner of said section; thence northwest diagonally across section No. 1, Texas Central Railway Co., and section No. 97, block 194, Gulf, Colorado & Santa Fe Railway Co., to the northeast corner of section No. 96; thence in a northerly direction across section No. 94 to a point in its northern boundary 600 varas west of its northeast corner; thence continuing north through sections Nos. 93, 90, 89, 86, 85, and 58, block 194, Gulf, Colorado & Santa Fe Railway Co., to a point on the northern boundary of said section No. 58; thence northwesterly with the pasture fence through section No. 59 to the northeast corner of section No. 82 and the southeast corner of section No. 81, same block; thence continuing northwesterly to section No. 17, Houston & Great Northern Railroad Co.; thence north along the eastern boundary of said section No. 17 to the Pecos River; thence northwesterly along said Pecos River to the northwest corner of Crockett County.

During the continuance of this quarantine no cattle of the counties of King, Stonewall, Fisher, Jones, and Reagan; those parts of the counties of Foard, Knox, and Haskell west of the Kansas City, Mexico & Orient Railway; that part of Hardeman County south of the Fort Worth & Denver City Railway and west of the Kansas City, Mexico & Orient Railway, or those parts of Howard and Mitchell Counties south of the Texas & Pacific Railway, shall be moved or allowed to move, except as provided for immediate slaughter, to any point in the United States not in the State of Texas which is located in an area not quarantined for splenetic, southern, or Texas fever, unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months, and unless and until the cattle shall have been inspected and found

free of infection and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped. Each application for inspection shall be duly made by the owner or the manager of the cattle on blank forms furnished by the department, and should be placed in the hands of the inspector of the Bureau of Animal Industry in charge of the district not less than 10 days in advance of the date on which inspection is required. Such applications for inspection shall be accompanied by affidavits when required by the said inspector.

From the other counties and parts of counties in the State of Texas quarantined for splenetic, southern, or Texas fever, cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

OKLAHOMA.

The entire State of Oklahoma is quarantined except the counties of Cimarron, Texas, Beaver, Harper, Woods, Alfalfa, Grant, Woodward, Major, Ellis, Garfield, Dewey, Blaine, Kingfisher, Logan, Roger Mills, Custer, Beckham, Washita, Greer, Kiowa, Caddo, Jackson, Oklahoma, Harmon, Canadian, Kay, Noble, and Payne; that part of Cleveland County north of the line between townships 7 and 8 north, and west of the Indian meridian; that part of Swanson County north of the line between townships 4 and 5 north; that part of Pottawatomie County included in townships 10 and 11 north, range 2 east; that part of Pawnee County west of the Missouri, Kansas & Texas Railway; that part of Lincoln County west of the Atchison, Topeka & Santa Fe Railway and north of the line between townships 13 and 14 north; that part of Grady County west of the Chicago, Rock Island & Pacific Railway and north of the St. Louis & San Francisco Railroad; that part of Osage County west of a line beginning at the Kansas State line between sections 17 and 18 in range 6 east; thence south on section line to line between townships 28 and 29 north; thence east on section line to line between sections 2 and 3, township 28 north, range 6 east; thence south on section line to line between townships 25 and 26 north; thence east on section line to its intersection with line between ranges 6 and 7 east; thence south on section line to its intersection with line between townships 23 and 24 north; thence east on section line to its intersection with line between sections 5 and 6, township 23 north, range 7 east; thence south on section line to its intersection with the Arkansas River.

From the counties and parts of counties in the State of Oklahoma quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

MISSOURI.

That part of Ripley County east of the fifth principal meridian; that part of Oregon County south of the line between townships 22 and 23 north; that part of Newton County west of the right of way of the Kansas City Southern Railway; and that part of McDonald County west of the right of way of the Kansas City Southern Railway are quarantined.

During the continuance of this quarantine no cattle of those parts of Ripley, Oregon, Newton, and McDonald Counties hereinbefore described shall be moved or allowed to move, except as provided for immediate slaughter, to any point in the United States not in the State of Missouri which is located in an area not quarantined for splenetic, southern, or Texas fever, unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months, and unless and until the cattle shall have been inspected and found free of infection and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped.

ARKANSAS.

The entire State of Arkansas is quarantined except the counties of Carroll, Randolph, Clay, Greene, Lawrence, Craighead, Mississippi, Poinsett, Benton, Washington, Madison, and that part of Crittenden County east of the main channel of the Mississippi River and known as Brandywine Island.

During the continuance of this quarantine no cattle of that part of Fulton County east of Spring River, or that part of Sharp County north of Strawberry River, shall be moved or allowed to move, except as provided for immediate slaughter, to any point in the United States not in the State of Arkansas which is located in an area not quarantined for splenetic, southern, or Texas fever, unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six

months, and unless and until the cattle shall have been inspected and found free of infection and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped.

From the other counties and parts of counties in the State of Arkansas quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

MISSISSIPPI.

The entire State of Mississippi is quarantined except the counties of De Soto, Tate, and Tunica; that part of Marshall County north and west of the Illinois Central Railroad; and that part of Benton County north of Tippah Creek.

From the counties and parts of counties in the State of Mississippi quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

TENNESSEE.

The following-mentioned counties and parts of counties are quarantined: The counties of Hardeman, McNairy, Chester, Henderson, Decatur, Hardin, Wayne, and Hamilton; that part of Marion County south and east of the Tennessee River; that part of Polk County south of the Hiawassee River; that part of Lawrence County south of the line beginning where the Pulaski and Lawrenceburg public road intersects the Giles County line; thence in a westerly direction following said road to Lawrenceburg; thence following the Waterloo road west 2 miles; thence northwesterly following the Lawrenceburg and Waynesboro public road to its intersection with the Wayne County line; and that part of Benton County west of the Camden, Coxburg, and Sugar Tree public road and south of the Nashville, Chattanooga & St. Louis Railway from its intersection with the said public road at Camden to the Carroll County line.

From the counties and parts of counties in the State of Tennessee quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

GEORGIA.

The entire State of Georgia is quarantined except the counties of Union, Towns, Rabun, White, Habersham, and Stephens.

From the counties in the State of Georgia quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

SOUTH CAROLINA.

The entire State of South Carolina is quarantined except the counties of Oconee, Pickens, Greenville, and Anderson.

From the counties in the State of South Carolina quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

NORTH CAROLINA.

The counties of Moore, Harnett, Johnston, Wilson, Northampton, Hertford, Bertie, Gates, Chowan, Perquimans, Pasquotank, Camden, Currituck, Edgecombe, Martin, Washington, Tyrrell, Dare, Hyde, Beaufort, Pitt, Wayne, Sampson, Cumberland, Scotland, Robeson, Bladen, Greene, Lenoir, Craven, Pamlico, Carteret, Jones, Duplin, Onslow, Pender, Columbus, Brunswick, and New Hanover are quarantined.

From the counties in the State of North Carolina quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

VIRGINIA.

The counties of Sussex, Surry, Southampton, Isle of Wight, and Nansemond; that part of Greenesville County south of Meherrin River; that part of Warwick County not included in the Newport News magisterial district; and that part of York County not included in the Bruton magisterial district are quarantined.

From the counties and parts of counties in the State of Virginia quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

LOUISIANA.

The entire State of Louisiana is quarantined.

During the continuance of this quarantine no cattle of the parishes of Lincoln and Claiborne shall be moved or allowed to move, except as provided for immediate slaughter, to any point in the United States not in the State of Louisiana, which is located in an area not quarantined for splenetic, southern, or Texas fever, unless and until the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months, and unless and until the cattle shall have been inspected and found free of infection, and a certificate authorizing the shipment issued by an inspector of the Bureau of Animal Industry, nor until permission shall have been obtained in advance of the movement from the proper official of the State or Territory into which the cattle are to be shipped.

From the other parishes in the State of Louisiana quarantined for splenetic, southern, or Texas fever cattle shall only be moved or allowed to move interstate to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

ALABAMA, FLORIDA.

The entire States of Alabama and Florida are quarantined.

From the States of Alabama and Florida cattle shall only be moved or allowed to move to points outside of the quarantined area in accordance with the regulations for immediate slaughter.

GENERAL PROVISIONS.

During the continuance of the quarantine as herein established no cattle of the quarantined area of any State (except those portions from which cattle may be moved upon inspection) shall be moved or allowed to move to any portion of the quarantined area of another State from which, under the specific provisions of this rule, cattle are allowed to be shipped for purposes other than immediate slaughter upon inspection and certification by an inspector of the Bureau of Animal Industry.

In case cattle are moved or allowed to move from the area quarantined for splenetic, southern, or Texas fever in violation of the rule and regulations of this department to prevent the spread of splenetic fever in cattle, such cattle shall be immediately returned to such quarantined area or they shall be quarantined.

OPEN SEASON.

During the months of January, November, and December of each year cattle of the quarantined area of any State may be moved interstate therefrom for purposes other than immediate slaughter into the States of Kansas and Kentucky, the Territories of Arizona and New Mexico, those parts of the States of California and Texas not included in the quarantined area, and that part of the State of Missouri south of the Missouri River if the said cattle shall have been continuously kept on premises known to have been free of infection for at least six months and shall first have been inspected under proper facilities for inspection at the point of origin and found free of infection and a certificate authorizing the movement issued by an inspector of the Bureau of Animal Industry, and if permission shall first have been obtained from the proper official of the State or Territory to which the cattle are destined.

During the period from November 15 of each year to January 31 of the following year cattle of the quarantined area of any State may be moved interstate therefrom for purposes other than immediate slaughter under the above-mentioned restrictions into that part of the State of Arkansas not included in the quarantined area.

During the months of January and February, the first 15 days of March, and the last 16 days of December in each year cattle of the quarantined area of any State may be moved interstate therefrom for purposes other than immediate slaughter under the above-mentioned restrictions into those parts of the States of Virginia and South Carolina not included in the quarantined area.

During the month of January and the last 17 days of December in each year cattle of the quarantined area of any State may be moved interstate therefrom for purposes other than immediate slaughter under the above-mentioned restrictions into that part of the State of Oklahoma not included in the quarantined area.

Cattle of the quarantined area that have been shipped interstate during the months of January, November, and December of each year to any State or Territory outside of the quarantined area other than those States or Territories and parts thereof set out herein, shall not be moved into any of the States or Territories or parts thereof hereinbefore mentioned within three months of the date of the movement from the quarantined area.

Cattle which are moved interstate from the quarantined area of any State into those States or Territories or parts thereof hereinbefore mentioned, under certificates from

inspectors of the Bureau of Animal Industry, for feeding or stocking purposes, shall, when shipped, be transported in cleaned and disinfected cars or boats, and shall not be placed in stock pens which have been reserved for cattle originating in the quarantined area.

FEEDING STATIONS FOR NONINFECTED CATTLE.

Cattle not of the quarantined area which are transported interstate by rail through the quarantined area may be unloaded therein for rest, feed, and water, into properly equipped noninfectious pens set apart for such cattle at the Fort Worth stockyards at Fort Worth, Tex.; the stockyards of the Missouri, Kansas & Texas Railway at Hodge and Denison, Tex.; the stockyards of the International & Great Northern Railroad at Laredo, Tex.; the stockyards of the Texas & Pacific Railway at Baird, Tex.; the Union Stock Yards, S. A., San Antonio, Tex.; the stockyards of the St. Louis & San Francisco Railroad at Sapulpa, Okla.; the stockyards of the Missouri, Kansas & Texas Railway at Muskogee, Okla.; and at such other points as may from time to time be authorized by the Secretary of Agriculture, provided such pens and the platforms, chutes, and alleyways leading thereto have been cleaned and disinfected under the supervision of an employee of the Bureau of Animal Industry, and are constructed and maintained in accordance with the specifications set out in the regulations of the Secretary of Agriculture to prevent the spread of splenetic fever in cattle.

All cattle handled in such noninfectious pens shall be free from ticks (*Margaropus annulatus*) and shall not have been unloaded at any point in the quarantined area other than the designated unloading points named herein or hereafter authorized by the Secretary of Agriculture, and they shall be reloaded into the same cars from which unloaded, or into other cars which have been cleaned, washed, and disinfected, as required by B. A. I. Order 143, and amendments thereto, immediately before loading therein, and reshipped as uninfected cattle.

ARSENICAL SOLUTION.

In accordance with the provisions of Regulation 17 of the Regulations of the Secretary of Agriculture governing the inspection, disinfection, certification, treatment, handling, and method and manner of delivery and shipment of live stock which is the subject of interstate commerce, cattle of the area quarantined on account of splenetic, southern, or Texas fever or other cattle infested with or exposed to ticks (*Margaropus annulatus*) may be dipped, under the supervision of an inspector of the Bureau of Animal Industry, in the standard arsenical solution, and when properly certified by said inspector to be free of infection may be shipped interstate for purposes other than immediate slaughter, subject only to such restrictions as may be imposed by the authorities at destination; provided that such cattle shall be dipped twice, with an interval of from 7 to 10 days between the first and second dippings; that the cattle shall be considered infectious and shall be handled as such during the interval between dippings; that the cattle shall not be exposed to infection after the second dipping; and that the facilities for preparing the dip and dipping the cattle shall first have been approved by the Chief of the Bureau of Animal Industry.

In preparing each 500 gallons of the standard arsenical solution there shall be used 10 pounds of finely powdered white arsenic containing not less than 99 per cent of arsenic trioxid, 25 pounds of sal soda, and 1 gallon of pine tar. The arsenic and sal soda shall be boiled together in not less than 25 gallons of water for 15 minutes, or longer if necessary to effect complete solution of the arsenic. Before the pine tar is added the temperature of the solution shall be reduced to 140° F. This may be done by the addition of cold water. The pine tar shall then be added in a small stream while the solution is thoroughly stirred, after which the solution shall be immediately diluted with clear water sufficient to make 500 gallons of dip.

INTERPRETATION.

This Rule 1, Revision 8, shall be construed in connection with the Regulations of the Secretary of Agriculture promulgated March 22, 1907 (B. A. I. Order 143), and effective on and after April 15, 1907, and amendments thereto, and is subject to amendment or revision on statutory notice.

Rule 1, Revision 7, dated March 9, 1911, effective March 15, 1911, shall cease to be effective on and after November 1, 1911, on and after which date this Rule 1, Revision 8, which for purposes of identification is designated as B. A. I. Order 183, shall become and be effective until otherwise ordered.

The effect of this order is as follows:

In California the county of Santa Barbara is released from quarantine.

In Oklahoma portions of the counties of Kay, Noble, Payne, Pawnee, Lincoln, Grady, and Osage are released from quarantine.

In Missouri a portion of Ripley County is released from quarantine.

In Arkansas Madison County and a portion of Crittenden County are released from quarantine.

In North Carolina the counties of Lee, Nash, Halifax, and Richmond are released from quarantine.

In Virginia a portion of Greenesville County is released from quarantine.

San Antonio, Tex., is added to the list of feeding stations for noninfected cattle.

Done at Washington this 20th day of October, 1911.

Witness my hand and the seal of the Department of Agriculture.

[SEAL.] JAMES WILSON, *Secretary of Agriculture.*

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B. A. I. ORDER 184.

## Special Order Modifying the Tuberculin-Test Requirement for Canadian Cattle Imported Temporarily for Exhibition Purposes at the International Live Stock Exposition, Chicago, Ill.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
*Washington, D. C., November 13, 1911.*

Under authority conferred upon the Chief of the Bureau of Animal Industry by Regulation 39 of Bureau of Animal Industry Order 180, "Regulations for the inspection and quarantine of horses, cattle, sheep, swine, and other animals imported into the United States," the requirements of Regulation 38 of Order 180 are hereby waived for cattle to be imported from Canada temporarily for exhibition purposes at the International Live Stock Exposition, to be held at Chicago, Ill., from December 2 to December 9, 1911.

The provisions of said Regulation 39 shall be strictly applied to the cattle covered by this order. Regulation 39 reads as follows:

REGULATION 39.—The Chief of the Bureau of Animal Industry may, however, by written order waive the foregoing tuberculin-test requirement for cattle which are to be imported temporarily for exhibition purposes, provided such cattle are accompanied by a satisfactory certificate of tuberculin test by a veterinarian in the employ of and receiving a salary from the Canadian Government made not more than six months previously and an affidavit by the owner or importer stating that the said certificate of tuberculin test refers to the cattle in question. Any such cattle which are not sold to remain in the United States shall be returned immediately to Canada at the close of the exhibition. The department must be notified of any Canadian cattle which will remain in the United States not tested as required by Regulation 38, and the tuberculin test will be applied to them by an inspector of this department before shipment to destination. All cattle, sheep, and swine intended for exhibition purposes must be shipped directly to the exhibition grounds and must not be unloaded in any public stock yards.

A. D. MELVIN,
*Chief of the Bureau of Animal Industry.*

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B. A. I. ORDER 185.

## Special Order Providing for the Importation of Canadian Sheep for Exhibition Purposes at the International Live Stock Exposition, Chicago, Ill.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
*Washington, D. C., November 13, 1911.*

*It is hereby ordered,* That from this date to December 6, 1911, Canadian sheep may be imported into the United States for exhibition purposes at the International Live Stock Exposition, to be held at Chicago, Ill., from December 2 to December 9, 1911, without being subject to the 30 days' quarantine, provided they pass a satisfactory inspection at the port of entry and are accompanied by an affidavit of the owner or importer and a certificate issued by a Canadian official veterinarian, as required by Regulation 42 of B. A. I. Order 180, "Regulations for the inspection and quarantine of horses, cattle, sheep, swine, and other animals imported into the United States." *And provided further,* That the sheep which are not sold to remain in the United States shall be returned immediately to Canada at the close of said exposition.

The department must be notified by the owner or importer, through the office of its veterinary inspector in charge at Chicago, of any Canadian sheep which are to remain in the United States for breeding purposes, and such sheep will be maintained in quarantine at the exposition grounds under the supervision of an inspector of this department, who shall issue a certificate before shipment to destination is allowed.

The 30 days of quarantine will be counted from the date of entry into the United States.

All Canadian sheep intended for this exposition must be shipped directly to the exposition grounds and must not be unloaded in any public stockyards.

JAMES WILSON, *Secretary of Agriculture.*

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## Notice Regarding the Interstate Movement of Cattle, Sheep, and Swine Which Are Affected with Lip-and-Leg Ulceration (Necrobacillosis).

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
*Washington, D. C., August 10, 1911.*

The attention of managers and agents of railroads and transportation companies, of stockmen, and others interested in the interstate movement of live stock is directed to the provisions of section 6 of the Act of Congress approved May 29, 1884, which prohibits the interstate movement of live stock affected with any contagious, infectious, or communicable disease.

Under this section it is a misdemeanor, punishable by fine and imprisonment, for any person or corporation to deliver for transportation, receive for transportation, transport, drive on foot, or otherwise remove from one State or Territory or District of Columbia into another State or Territory or the District of Columbia any cattle, sheep, or swine which are affected with lip-and-leg ulceration (*necrobacillosis*), and which by a physical examination show the disease in more than one tissue or lesions of the disease with pus formation. However, sheep which are affected with the mild or inactive form of lip-and-leg ulceration involving the lips or face without evidence of pus formation may be moved interstate, provided the affected parts are immediately before such movement treated with an emollient dressing containing 100 parts mutton tallow, vaseline, or lard, 10 parts flowers of sulphur, and 5 parts pure carbolic acid. (In lieu of the carbolic acid three parts liquor cresolis compositus, U. S. P., may be used.) When this treatment is given at public stockyards, where Federal inspection is maintained, it should be done under the supervision of an employée of the Bureau of Animal Industry.

JAMES WILSON, *Secretary of Agriculture.*

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